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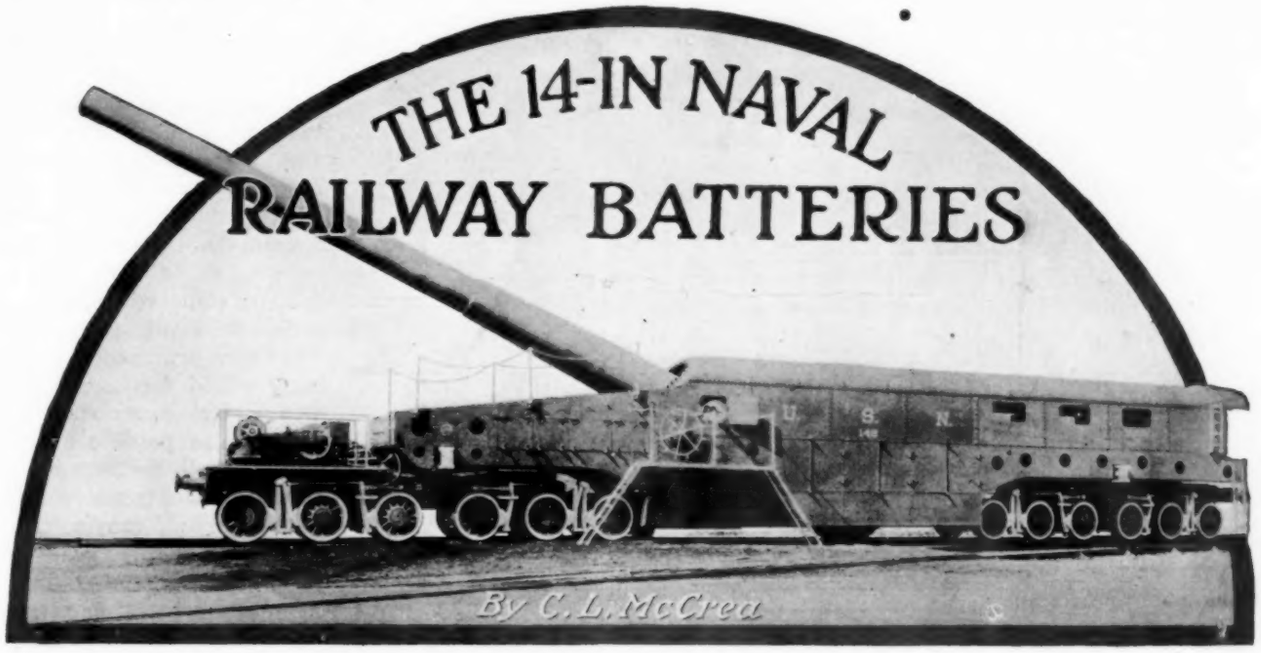
THE 14-IN NAVAL RAILWAY BATTERIES



With the close of the war more complete details are available regarding the design and construction of the Navy's expedition of 14-in. guns on railway mounts that were sent to France to assist our Army on the Western Front, and the full story of how the Navy Bureau of Ordnance succeeded in designing, constructing in the United States, shipping and reerecting abroad and placing in action on the fighting front this battery of finest guns in the war may now be told.

JUST a little over a year ago, Rear Admiral Ralph Earle, Chief of the Navy Bureau of Ordnance, decided that a number of 14-in. 50-caliber guns that were originally intended for installation on ships could in an emergency be diverted to other uses. This size of gun at that time had but a single rival for size and range—that was the German gun which for some time past had been bombarding Dunkirk and which had wrought a great deal of destruction there. It was early seen therefore that if these guns could be mounted and placed in the hands of the armies in France they would be of great value to the Allies.

The immediate question for Admiral Earle and his assistants to answer was how to use the guns. A conference of department heads was called and two main points were decided. First of all it was felt that the greatest and most advantageous service from these guns could be obtained only by making them completely mobile, and this mobility could be obtained only by placing them on railroad carriages. In the second place it was decided that the element of time was a most vital factor, and that unless the guns were ready for firing in the summer of 1918—a date less than nine months distant—the fullest use could not be got from them.

Acting immediately on the decision of the conference the designers went to work on Dec. 26, 1917, on blanket instructions to prepare general plans for a railroad mounting capable of carrying the 14-in. 50-caliber naval gun, to be complete with all operating equipment. This is shown in its entirety in the headpiece.

The first step in designing the naval railway mount was to obtain data on the French railways, their track gage, clearances, etc., and study them. Although the

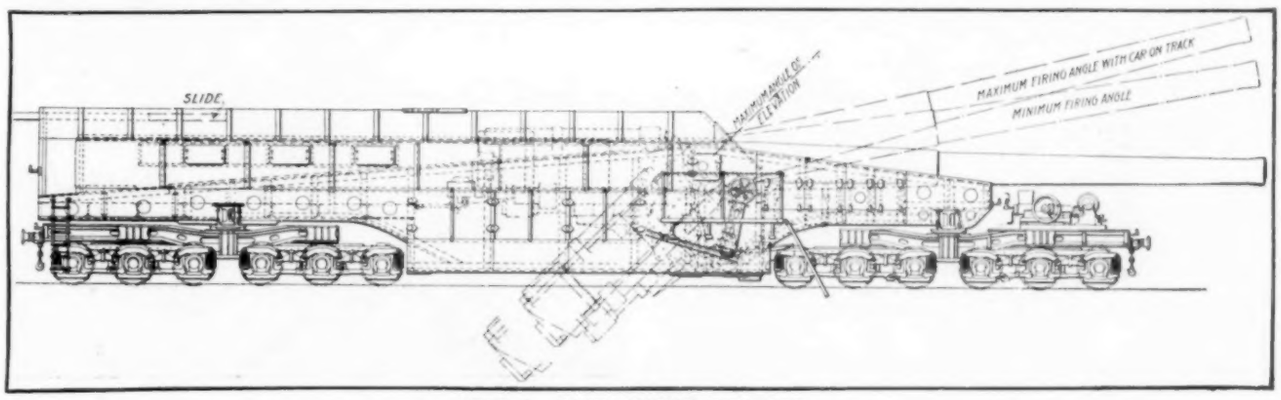


FIG. 1. 14-IN. NAVAL-GUN CAR

French clearances differ considerably from American practice it was found possible to work within them and still use American standards. Time was the vital factor everywhere. The designers were asked to do in weeks what would normally take months, and so the first question the designers asked themselves was, "How can we adapt, as far as possible, the mounts in which these guns are carried on board ship so as to use them on shore?"

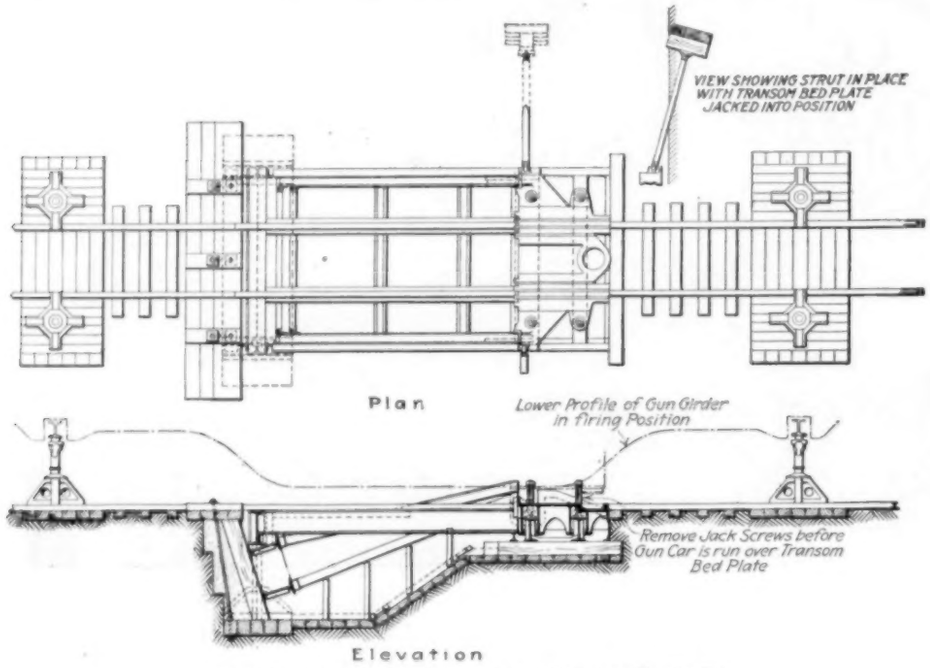

VIEW SHOWING STRUT IN PLACE WITH TRANSOM BED PLATE JACKED INTO POSITION
Plan
Lower Profile of Gun Girder in firing Position
Remove Jack Screws before Gun Car is run over Transom Bed Plate
Elevation

FIG. 2. FOUNDATION FOR HIGH-ANGLE FIRE

On board our battleships these heavy guns are of course mounted in the turrets. The gun itself is finished smooth on the outside; that is, there are no trunnions attached directly to it. At the breech end a heavy yoke casting is attached and the gun is placed within a heavy cylindrical casting known as the gun slide. This slide is machined to a bearing surface on the inside and fitted with bronze liners on which the gun bears. The outside of the gun slide carries the trunnions. The trunnions in turn rest on two heavy steel castings, which are bolted directly to the ship's structure, called the deck lugs. The recoil of the gun on firing is taken up by a hydraulic-brake cylinder attached underneath the slide and connected to the yoke of the gun. After the gun has recoiled it is brought back into battery, or firing, position by means of heavy helical springs placed in four cylinders attached to the gun slide and operating on pistons attached to the gun yoke.

Conditions on board ship had forced the designers of this material to carefully calculate factors of safety and to keep their designs as compact as possible, and careful consideration of the design of battleship turret mounts showed that it should be possible to use a great deal of standard Navy material in a railway mount. The first principle the designers laid down therefore was that as much standard material as possible should be used, both for reasons of proved reliability and of saving in time of construction. A study of the few available general designs of railway mounts previously developed by the French and some rapid calculations showed that it would be possible to mount the gun with its slide and lugs between a pair of heavy bridge girders, these girders in turn being supported on railway trucks. The question of elevating the gun and taking care of its recoil then came up.

The 14-in. 50-caliber gun is 50 x 14 in. = 700 in. or 58⅓ ft. long. To properly balance the gun and slide when in firing position the axis of the trunnions is placed 16 ft. 10½ in. from the face of the breech. When the gun fires it recoils in its slide a distance of 44 in., making a total clear space necessary from the axis of the trunnions of somewhat over 20 ft. As the maximum height above the rail heads permitted by French tunnel clearances is 13 ft. 1⅞ in. it is readily seen that the

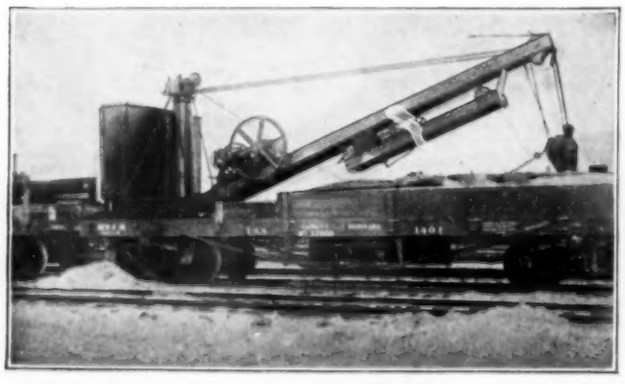


FIG. 3. THE CRANE CAR

FIG. 4. GUN READY TO FIRE

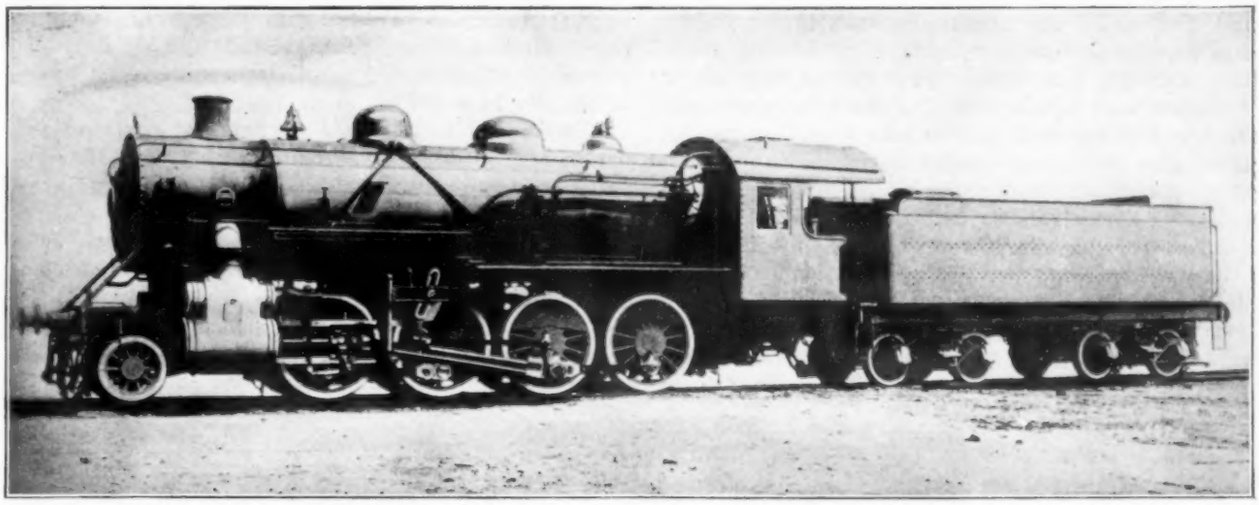


FIG. 5. THE LOCOMOTIVE

designers were called upon to provide some method of taking care of the recoil of the guns when firing if the guns were to fire at all angles of elevation up to about 45 deg., at which the greatest range is obtained.

Three methods of caring for the recoil of the gun were available. The first was to move the trunnions nearer to the breech end of the gun and to add either a counterweight to the breach, or a spring cylinder, air buffer, etc., to overcome the muzzle preponderance which would then be given to the gun. This would have necessitated an entirely new design of gun slide, recoil mechanism, etc., and it was promptly ruled from consideration. The second method evident was to provide a means for elevating the entire gun with its slides, lugs, etc., preparatory to firing, while the third method was to dig a pit and provide a structural steel and timber foundation on which the gun might rest when firing at high angles of elevation.

Each of the last two methods offered a practical solution of the problem, with certain advantages inherent in each method. The method of elevating the trunnions would be the only practical solution if the guns were to operate in a country where a great deal of rock is encountered two or three feet beneath the surface, as excavation would then be too difficult to permit digging a pit. The pit, however, could be easily dug in the soil of France, as such conditions do not prevail there.

The decision was made by considering the probable use of the guns. It was felt that these naval railway guns would find their greatest use in firing on fixed targets that were of more than ordinary importance to the enemy; for instance, large ammunition dumps, railway centers, yards, etc., far behind the enemy lines. The destruction of these strategic points calls for extremely accurate firing, for although a single well-placed shot from this gun will create havoc in the enemy communications, etc., the gun must be very carefully aimed and placed in position to accomplish this. When the gun fires directly from the rails the entire gun moves backward a distance of some 25 ft. and must be placed into position and reaimed, etc., after each shot. When the gun fires from a pit a fixed foundation is obtained, and the railway mount for all purposes then becomes the equal of a fixed land mount and permits of extremely accurate and rapid firing. All these considerations were taken into account, and it was decided to provide for a pit with a structural-steel foundation to support the gun when firing at angles of elevation at which the breech of the gun would interfere with the railway tracks.

In order that the naval railway battery might successfully operate independently along the fighting front wherever needed it was decided that complete equipment of every description should be carried with the

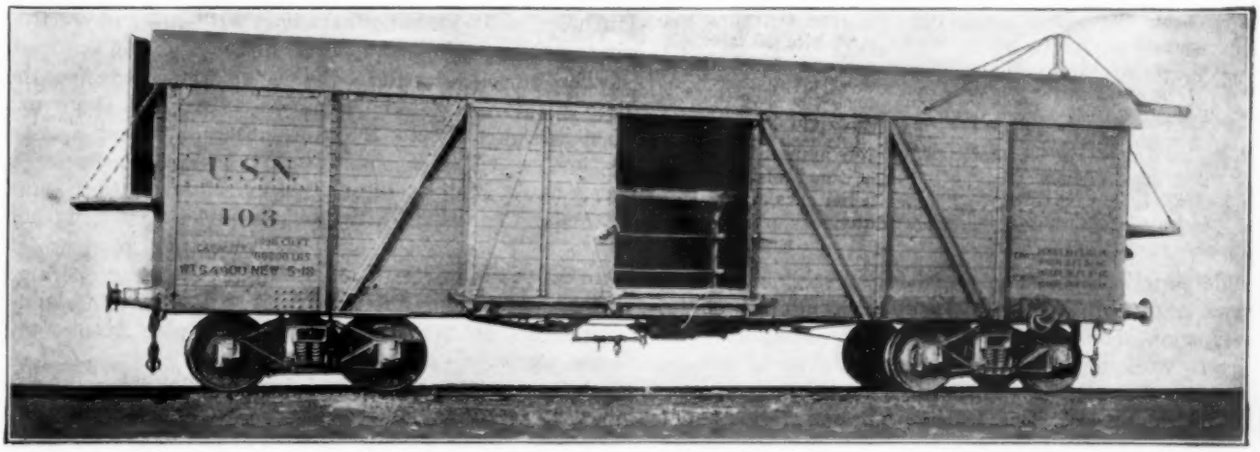


FIG. 6. AMMUNITION CAR

guns. This called for ammunition cars to carry shell and powder for the gun, construction cars to carry foundation material, with means for installing it, berthing and kitchen cars for housing the operating personnel, workshop, fuel and headquarters cars, etc.

Here again, for considerations of time, a second principle of design was laid down, which was that standard United States railway material should be used to the fullest possible extent and only such modifications as were necessary to permit its operation on French railroads should be introduced.

Sundays and holidays were sacrificed and the general designs for the naval railway batteries were out within a few days. They called for an initial construction of

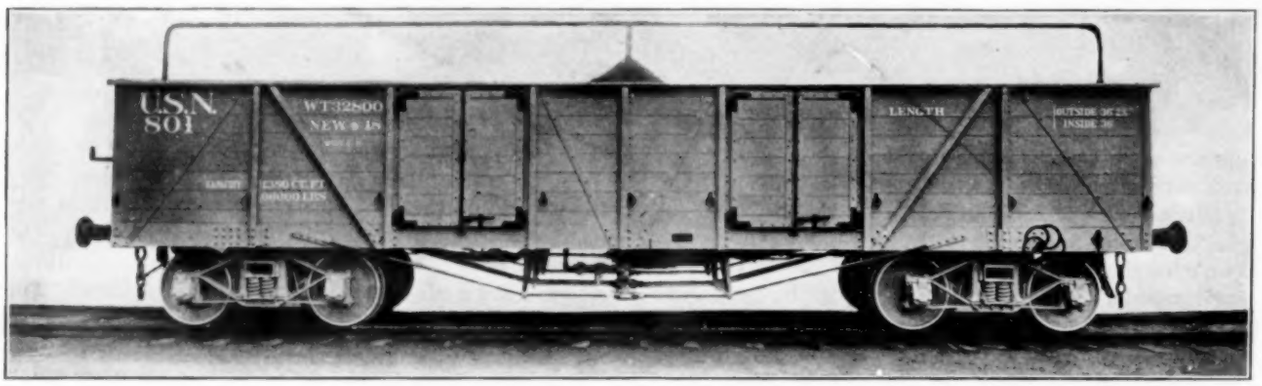


FIG. 7. CONSTRUCTION CAR, GONDOLA TYPE

five battery units, each battery unit composed as follows:

One gun car consisting of two large main girders, each 72 ft. long, braced and tied together to form a single girder unit with a large center well in which the 14-in., 50-caliber gun with its slide, deck lugs, elevating gear, etc., was mounted; the gun was arranged to fire from the rails at angles of elevation up to 15 deg.; for firing at elevations from 15 deg. to 43 deg. a foundation composed principally of ordinary structural steel girders and timbers was provided. One locomotive. Two ammunition cars. One construction (gondola) car. One construction (flat) car with crane. One sand and log (box) car (the latter three for carrying foundation material and installing it). One workshop car. One fuel car. Three berthing cars, and one kitchen car for housing operating personnel. Two battery-headquarters cars for operating the trains, housing officers, etc.

In addition provision was made for a staff train of:

One locomotive, one staff-quarters car, one traveling machine shop, one spare-parts car, one staff-kitchen and dispensary car, one staff-commissary car and one staff-berthing car.

In all the initial plans for five units called for:

Five gun cars, six locomotive cars, ten ammunition cars, five crane cars, eleven construction cars, ten fuel and workshop cars, sixteen berthing cars, six kitchen cars, one traveling machine shop and thirteen headquarters, commissary dispensary, etc., cars.

The practical basis on which the designs had been drawn and their evident feasibility brought forth immediate and complete approval and the designers went back to work on the details.

The heavy weights to be handled and the limitations of French tunnel clearances, track and bridge weights made the design a difficult problem and called for close and careful calculations. Some of the weights to be handled were, for example: The 14-in. gun, 85 tons (170,000 lb.); breech mechanism and yoke, 11¼ tons (22,500 lb.), and gun slide, complete with recoil and counterrecoil mechanism, 25¼ tons (50,700 lb.).

The gun was to be capable of firing at angles of elevation from 0 deg. to approximately 43 deg. The ensuing reactions due to firing are: at 0 deg., gun horizontal, trunnion pressure and resulting horizontal reaction, 814,000 lb.; at 43 deg., trunnion pressure, 966,000 lb.; resulting horizontal and vertical reactions, approximately 700,000 lb. each.

The detailed design and arrangement of the gun car is shown in Fig. 1.

Each of the two longitudinal main girders is 72 ft. long, with a maximum depth of approximately 8 ft. The firing load is very concentrated, and to properly care for it and insure its distribution through the girder section the web of the girder where the deck lugs are applied is made especially heavy. Special plates were necessary for this section. The two main girders are tied together and cross-braced at each end to form a single girder unit which weighs 135,800 lb. A special U-shaped housing is built in at either end of the girder, in which cast steel H-beams, each carrying a center-pin socket, are placed. The center-pin sockets of the H-beams respectively receive the center pins on two 12-wheel car trucks placed at each end of the girder on which it rests.

The construction of the trucks to carry the gun car is of course extremely and exceptionally heavy. Structural-steel girder beams form the frames of the trucks and carry the load to the axles. The axles of the trucks turn in 9 x 12-in. boxes arranged with coil and equalizing springs to insure an even distribution of the load.

The gun is placed in the well formed between the two girders. To accomplish this the deck lugs are fastened directly to the web at its heaviest section by means of steel bolts ground to size to insure a correct fit and an even transmission of the firing stresses. The slide, with the gun and its yoke, is then installed between the lugs, the elevating gear, which consists of a worm in an oscillating bearing operated by hand through a train of gears, as shown, being placed beneath and fastened to the girder flanges and cross-pieces.

Sufficient clear space is left behind the face of the breech of the gun, so that when the gun fires at angles of elevation not greater than 15 deg. (at 15-deg. elevation the range of the gun is 23,000 yd.) all that is

necessary is to set the hand brakes on the gun car after the gun has been properly aimed and fired. The recoil of the gun is absorbed by the hydraulic brake, and the resultant reaction on the gun car is taken up in moving the entire car backward along the tracks. At 15 deg. the gun car moves backward a distance of about 25 ft. The trunnions of the gun are placed so that the load on the axles of front and rear trucks is equalized on firing.

To enable the gun to fire at angles of elevation greater than 15 deg., arrangements for a pit and foundation, as mentioned above, have been provided. Immediately below the elevating gear and securely fastened to the girder webs and flanges is a heavy steel casting called the transom bedplate casting. A similar casting is provided in the foundation. The entire foundation, Fig. 2, is prepared in advance, it usually taking the best part of a day to get it ready. It is of course prepared in advance of the arrival of the gun car at any point at which the gun is to operate. The pit is dug, and by means of the crane car, Fig. 3, the timber-work backing and the structural-steel girders are put in place. The foundation bedplate casting is then put into position, and the girder designed to carry the rails and the weight of the gun car when it is rolled into position over the foundation is placed.

To prepare the gun for firing from the pit foundation is then a matter of but a few minutes. The car is run over the foundation until the transom bedplate casting of the gun car is directly over the bedplate casting of the foundation. One-hundred-ton ball-bearing jacks are then placed under the corners of the H-beams at each end of the gun girder, and the entire gun car is lifted from the trucks a distance of about 4 in. By means of screw jacks provided in the bedplate casting of the foundation it is brought up until it engages with the transom bedplate casting of the gun car and the load of the car rests upon it. The girders carrying the railroad track are then moved to either side of the center line of the track, leaving a clear space in which the gun may recoil. Screw jacks are then placed under the heels of the girder to prevent side sway, and the 100-ton jacks are removed from the jacking beams, allowing the entire weight of the gun car to rest on the foundation. The gun is now ready to fire, as shown in Fig. 4.

Accurate aim when firing from the rails is obtained by firing from a curved track, a change in position of the gun car along the track causing a corresponding change in the azimuth of the gun. When firing from the pit, however, this is not possible. Accurate aim of the gun on the foundation is obtained through a traversing gear, which permits the entire gun girder to be swung about the forward H-beam center pin through a horizontal angle of 5 deg., 2½ deg. on each side of the center line of the tracks. As this angle of traverse represents a deflection on either side of the center line of 500 yd. at a range of 23,000 yd., corresponding to an elevation of 15 deg. and correspondingly greater deflections at greater elevations, it is evident that this angle of traverse is ample for all purposes.

The traversing gear is simply a wormshaft turning in a bearing cast integral with the rear H-jacking beam and operating against the girder. It is operated by ratchet wrenches and it has worked satisfactorily.

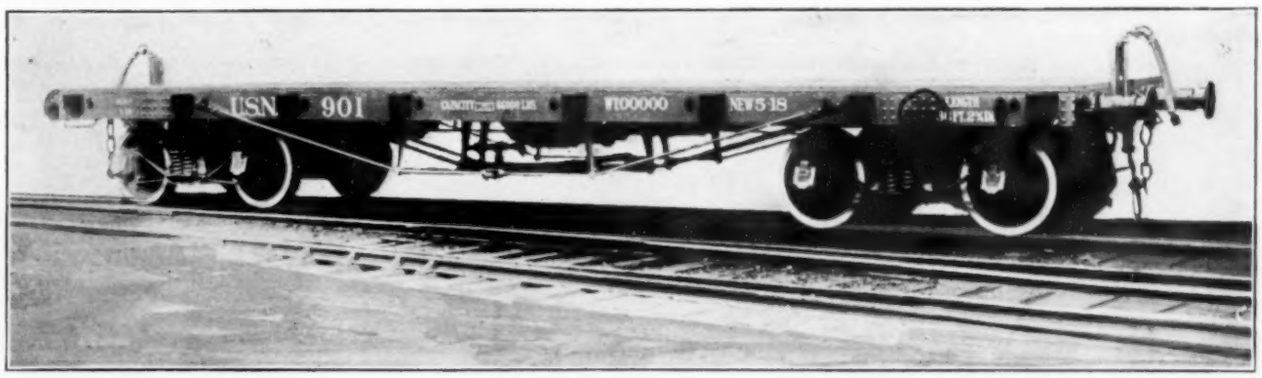


FIG. 8. CONSTRUCTION CAR, FLAT TYPE

The loading of the gun is done with an ingenious device consisting of a roller-bearing trolley car mounted in an inclined I-beam, the lower end of which is placed level with the breech of the gun when the gun is in loading position. The 1400-lb. projectile is brought from the ammunition car on a monorail hoist and placed on this trolley. The loading crew then grasps the handles at the sides of the trolley and run the length of the car with it. The car is brought to rest against hydraulic buffers at the end of the I-beam, while the momentum of the shell is sufficient to carry it the length of the powder chamber and into the bore of the gun, where it is brought to rest by the forcing of the copper rotating band into the rifling of the gun.

The entire gun car is sheathed in ¼-in. armor plate. A small combination gas-engine-driven air compressor and winch is placed on the forward truck of the gun car.

The problem of the design of the locomotives and the auxiliary cars of the battery was much simpler than that of the gun car.

The locomotives decided upon as necessary for the work of handling the entire train of cars, including the gun car, are standard consolidation-type locomotives, equipped for operation on French railways, as shown in Fig. 5.

As mentioned previously, one of the first points realized was that standard United States railway material should be used as far as possible, and only absolutely necessary modifications introduced. Only in this way could material be produced in time or, in fact, could it be obtained at any time during the war. Manufacturers had no time for extensive changes of design. Consequently all the cars of the expedition are

built fundamentally to American design, but with French operating devices, track gage, etc.

The ammunition cars are standard steel-frame box cars of 60,000 lb. capacity, as shown in Fig. 6. The roof is covered on the outside, and the sides are lined on the inside with armor plate similar to that which covers the gun car. Doors are placed in the ends of the cars, and a monorail trolley hoist is provided for handling the 1400-lb. shell and the powder tanks so that ammunition may be delivered directly to the loading device in the gun car. Each car has racks built to hold a total of 25 shells and 25 full charges of powder (fifty 280-lb. tanks). The ammunition cars, as well as the other auxiliary cars, are equipped with air brakes.

The construction cars, with the exception of the crane car, which mounts a 10-ton pillar crane provided with a counterbalance and has a boom radius of 21 ft., are standard flat and gondola cars, as shown in Figs. 7 and 8.

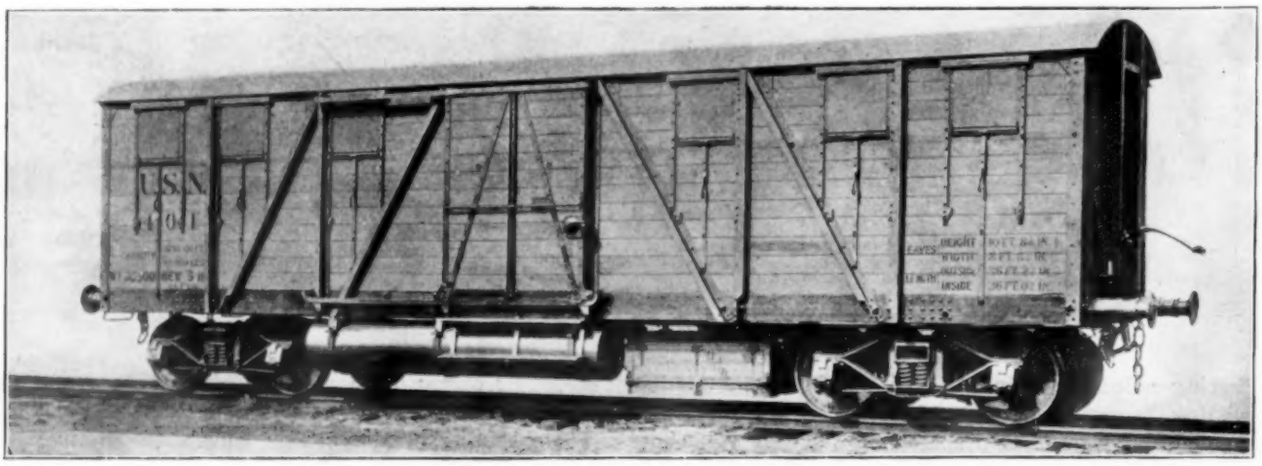


FIG. 9. BERTHING CAR

The berthing cars, one of which is shown in Fig. 9, are box cars provided with folding berths. These berths are placed in tiers of 3 each and supported by the side of the car.

The traveling machine shop is of special interest. It is equipped with a gasoline-engine-driven generator which supplies current to operate individual motor-driven machine tools placed in the car. This car contains a good-sized lathe, a drilling machine, a grinding machine, a forge and a work bench, so that ample facilities are provided for the repair of practically any breakage.

Every available man had been called to work on the project. Designs were being made, checked and traced simultaneously. Finally, in less than one month, they were finished and approved. On Jan. 25, 1918, they were pronounced complete and 136 standard drawings and 11 sketches were ready for submission to the bidders.

In the light of the extraordinary speed made in the drafting-room work on this project it would seem very probable that there would be a sacrifice in accuracy of detail, making changes necessary during the construction of the mounts. Not so with this work. Not a change was made that caused one minute's delay in the work of construction or assembling. The mounts were built exactly as designed—and they worked.

The story of the construction of the 14-in. railway mounts is a tale of marvelous speed. From the first it had been determined that the construction of these mounts would not be allowed to interfere with any work under contract for the United States Army or other important Navy projects. This of course greatly curtailed the possible sources of supply for naval railway battery material, as most of the leading locomotive builders, large machine shops and car-construction companies in the country were working to full capacity. Proposals, however, were sent out by telegraph calling for an opening of bids on Feb. 6, 1918. When the bids were opened on this date the results were not satisfactory, principally because the bidders had not realized the full importance of the project and the dates of deliveries set in their estimates were far too distant.

At the first opening of bids, however, representatives of leading railway-equipment manufacturers of the country were present in person and over the conference table the plans were explained to them. They asked for time to go back to their plants to consult with their directors and accordingly a second opening of bids was scheduled for Feb. 13.

The coöperation of manufacturers in making the project possible was more than pleasing, and at the second opening of bids a number of favorable proposals were received. Among them was the offer of the Baldwin Locomotive Works to undertake the construction of the gun cars and locomotives on a promise to deliver them about June 15. Similarly the Standard Steel Car Co. offered to undertake the entire work of constructing the 72 cars that were called for. By distributing the order among its various plants it was able to promise delivery in from 100 to 120 days. After consideration of all the bids these two were found to be the most favorable and the contracts were awarded on the same afternoon. On the same evening work was commenced on the preparation of the material.

Every war seems to have its one outstanding achievement in speed. During the Spanish-American War all records were broken by the U. S. S. "Oregon" in steaming from the Pacific Coast to Cuba. In the Boer War the famous gun, "Long Cecil," was built at Kimberley in 23 days. In this war the first 14-in. railway mount was completed in 72 days following award of the contract, and 120 days following the commencement of the first preliminary designs.

From the moment that bids were accepted and the contracts awarded the fabrication of material moved rapidly forward. Of course a delivery schedule was laid down. The most optimistic man at the Baldwin Locomotive Works, S. M. Vauclain, vice president, made it out himself—only to have it broken. The first mount was scheduled for delivery on May 15, 1918. The first mount rolled out of the Baldwin shops complete and ready for firing on Apr. 25, 1918. The last mount was scheduled for June 15. The last mount was finished May 25.

There were no changes in design to delay construction. Plates for the girders were rolled at Pittsburgh and rushed to the American Bridge Co.'s fabricating plant at Pencoyd in special cars with navy men perched on top of them to see that they got through on time.

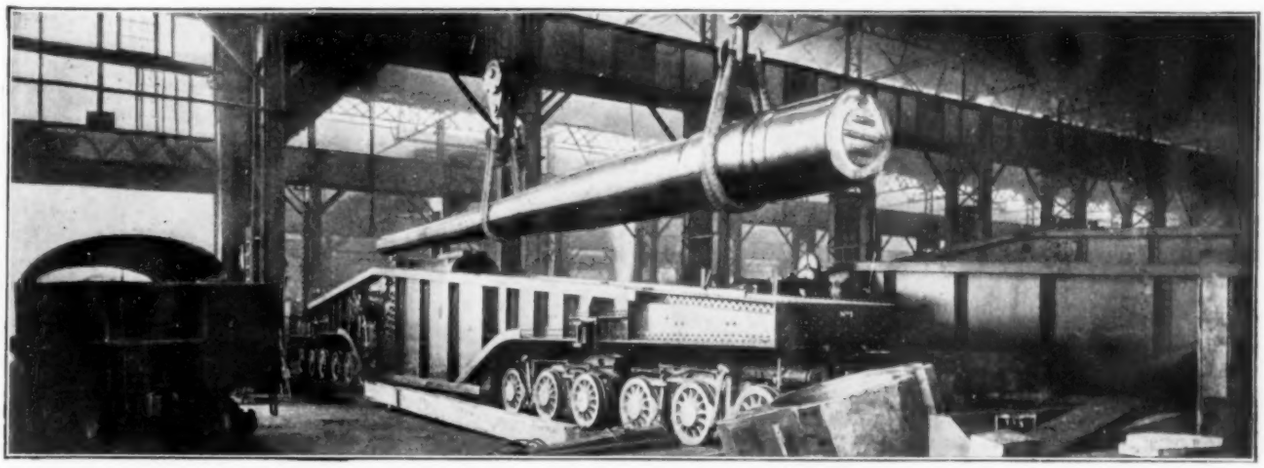


FIG. 10. GUN CAR IN BALDWIN SHOPS

At Pencoyd every available man went to work enthusiastically and the girders were fabricated in record time. The first girder unit was received at the Baldwin shops within one month after the order was placed. Meanwhile the work of constructing the trucks for the gun cars at the Baldwin plant at Philadelphia was progressing rapidly and at the Simonds Manufacturing Co.'s plant in Fitchburg, rolling of the armor plate was started. As fast as armor plate was completed and tested it was loaded on the Federal Express at Boston and brought through to Philadelphia without change of cars. The gun slide, deck lugs and elevating gear were machined by the Washington Navy Yard in record time, and where freight cars were not available to carry parts from the yard to Philadelphia auto trucks made the trip. In fact every conceivable method of transportation was used in seeing that material from contractors reached the Baldwin shops on time. Express cars, baggage cars, freight cars, auto trucks, special messengers and even suit cases were pressed into service.

While one end of the Baldwin shops was engaged in erecting the gun cars, as shown in Fig. 10, the other end was erecting the locomotives for the expedition. At the plants of the Standard Steel Car Co., located at various places throughout the country fabrication of the cars was pushed so that they too were finished in advance of their delivery schedule. In spite of a severe fire and a wind storm which destroyed a considerable portion of one of its large Western plants the contract was completed and the cars delivered by June 1. The start of a complete train of material from the Hammond, Ind., plant of the Standard Steel Car Co. destined for oversea shipment as part of the expedition made an interesting picture.

The naval bluejackets who were to comprise the operating personnel for the battery were selected from the men at the Great Lakes Training Station in February. Those who were to do the work of erecting the gun abroad and operating the train in France were trained in the use of the material by employment as inspectors at the various fabricating plants at work on the battery material. The crew which was to load, fire and actually operate the gun itself was trained by sending it to the Naval Proving Ground at Indian Head, Md., where it received a number of weeks' practical instruction along those lines.

On the morning of Apr. 25, 1918, the first gun car was completed and rolled from the erecting shop of the Baldwin Locomotives Works at Eddystone. After a few preliminary track tests the gun started on its way to Sandy Hook Proving Ground. It was necessary to use the Army Proving Ground at Sandy Hook, N. J., for the proof of this gun, as it was impossible to prove it at the Naval Proving Ground at Indian Head, Md. On the morning of Apr. 30, 1918, in the presence of a small party of Army and Navy representatives and foreign envoys the gun was fired from its railway mount. The test of the gun and its mount was eminently satisfactory in every respect.

Shipment of the Railway Mounts

General Pershing named St. Nazaire as the port of debarkation in his acceptance of the Navy's offer to furnish these guns for use with the American Army in France, and preparations to ship the guns to that port were immediately commenced. The shipment was not accomplished without difficulties. The first ship assigned for the work of transportation was badly battered by storms on her Western trip and forced into drydock for repairs. The second ship assigned was the "Texel," which was one of the first ships sunk by the German submarine U-151 operating off our coast. Finally, however, the steamship "Newport News," deeply loaded with material, sailed from Philadelphia on June 29, and other ships followed shortly thereafter.

The personnel for the naval railway batteries were

ordered abroad as soon as the port of debarkation was fixed and sailed immediately on a troop transport and arrived at St. Nazaire on June 9, 1918.

St. Nazaire has two great advantages for the erection of these batteries, namely, a 150-ton crane at one of the docks and French locomotive shops only a quarter of a mile away equipped with two 125-ton cranes. Outside of the locomotive shops there were a number of tracks available for the erection of the cars, etc., of the expedition and for the finishing touches on the gun cars after the heavy lifts had been accomplished in the locomotive shops. Two or three miles away were located the Montoir storehouses in which space was available for the storage of tools, material, etc., for the batteries. The 19th U. S. Engineers were located at St. Nazaire erecting locomotives for the American Expeditionary Forces. During the first week following their arrival the men of the battery were busy erecting barracks for their use, a site for which was obtained close to the erecting tracks. The barracks were made entirely by the bluejackets from scrap lumber from locomotive packing cases. The tracks on which erection was to take place were then rebuilt. A stationary boiler was borrowed, a leaky air-pipe line overhauled and compressed air for car erection made available.

After this work there was no navy work to do pending the arrival of the first shipload of material. But the men turned to with a vim that surprised everyone. Groups of mechanics were sent to the roundhouse to assist the force there; others went to help the 19th Engineers; still others went to work repairing the tracks in the yards, while switching crews were organized to clear up a congestion of work which had piled up and was delaying erection. The willing coöperation of the navy men and the spirit of "do what you can to lick the Kaiser" made them friends everywhere. It was more as a reward for the help they had given than anything else that the 19th Engineers cheerfully consented to lend one of their 35-ton steam-locomotive cranes for use during the erection of the navy material. But four of these cranes were available at St. Nazaire and all were in use. Without a crane rapid erection work would not have been possible.

The "Newport News" arrived at St. Nazaire on July 8. As the material was brought from the hold of the vessel it was taken to the erection tracks or storehouse and carefully placed in spaces previously laid out for it. A discouraging feature was that on the first shipload of material there were practically no complete units on which work might be started, and experience had shown that it was suicidal to attempt work on units for which all material had not arrived. The material had piled up at the Philadelphia Navy Yard until it was impossible to separate the ship units, and there was nothing to do but wait for the arrival of the second ship. The second and third shiploads of material both arrived on July 21, and erection work was on in earnest. One feature is worthy of special comment. The blueprints showing the assembly of all the cars of the expedition were sent by special mail from the United States so they would arrive at St. Nazaire amply in advance of the receipt of material that they might be studied. Whether they were on a ship sunk by submarine or how they were lost will probably never be known. The fact is they never arrived. New ones were ordered by cable from the United States, but by the time they were received the project was within a week of completion. The locomotives were assembled entirly without blueprints.

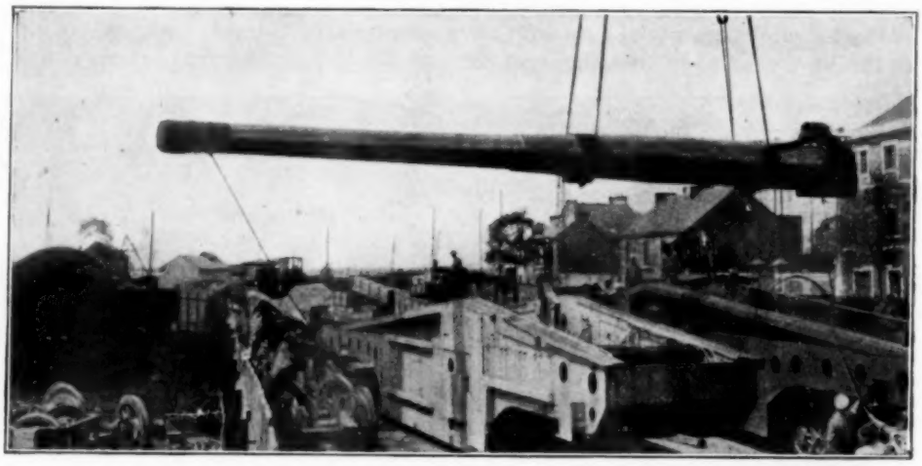


FIG. 11. LIFTING A GUN AT ST. NAZAIRE, FRANCE

The heaviest single lift for the crane was the gun girder. This was transported to the shops by placing it directly on the trucks, which had previously been erected, and hauling it on its own wheels. Only the heavy lifts were handled in the shops, as the cranes were in almost constant use by the engineers. As soon as the deck lugs and gun slide had been placed in a girder the gun was inserted in the slide, and the gun car was taken to the outside erecting tracks for completion.

The handling of the heavy 14-in. gun presented a problem. It was far too heavy for the light French flat cars, and as there was no heavy wrecking crane available a breakdown could not be risked. The difficulty was overcome by using the gun girder as a car on which to transport the gun, the gun being laid between the side girders. This operation is shown in progress in Fig. 11.

The car erection went ahead steadily on the outside tracks. Material had been placed so that a progressive movement of the cars was possible. The trucks were first assembled and the frames were then placed on them. The sides and roof of the cars then followed, and last of all the interior work. The task of erecting the gun cars was not nearly as difficult as the erection of the 70-odd cars for the expedition. On no car were there less than 500 rivets to be driven, and on one car there were over 1200. In this connection there was a handicap similar to the loss of the blueprints. Through some mishap the packages marked "rivets," on being opened, were found to contain stove bolts, and it was necessary to borrow rivets from all over France. As the only rivets available were in metric sizes, the cars

were put together with them. On some of the sizes for which no metric-sized rivets were available it was necessary to draw large rivets down to the proper size by hand. In spite of these difficulties, however, the erection of the cars was not delayed.

High-Pressure Work

All of the work was done under high pressure. There were insistent calls day after day from the front for the guns. They were needed, and needed at once. The response of the men to the call is worthy of the highest praise. The working hours were from 7:30 a.m. to noon and from 1:00 p.m. to 5:15 p.m., but when 5:15 p.m. came around the men would refuse to quit. In the long summer evenings in France it was possible to see up until almost 10 o'clock, and the men insisted on sticking to their jobs working steadily until it was too dark to see. It is principally to the wholehearted willing coöperation of the men that the remarkable record in the assembly of the batteries was made.

The first gun girder was unloaded from the ship and put in the shop on July 30. On Aug. 11 the completed gun car was ready to leave for the front in response to orders received from the French high command. With it there was a complete train of cars. The orders to leave were countermanded before the train started, however, and it was not until the 17th that the first train moved off. It was followed by train No. 2 on the 18th. The last gun car and its train left for the front on Sept. 13; the staff train was completed and moved on the 14th, on which day the barracks at St. Nazaire were evacuated and the storage house entirely cleaned out and turned over to the Engineers. The entire group of naval railway batteries was ready for action on the western front two days later.

Final Erection and Assembly

Designs started Dec. 26, 1917, and completed Jan. 25, 1918; contracts let Feb. 13, 1918; shipment commenced in June, 1918; final erection and assembly completed in France on Sept. 14, 1918, a total of 262 days from the date of the inception of the idea to its successful achievement, the naval railway batteries will stand for years as a record of a monumental task accomplished and will reflect undying credit on the officers and men who conceived, developed and forced the idea into existence. The Navy not only put into action the hardest hitting, the most accurate and the longest range guns in the war (merely excepting the German freak gun firing a 300-lb. shell in the general direction of Paris, sometimes hitting that city, sometimes not) but, as far as is known, provided the only high-powered heavy artillery used by the American Army in France up to the signing of the armistice.

The story of the operation of the naval railway batteries is a long one, and it will be told in due time. It need only be said here that the devastation wrought by their enormous shells of steel and high explosive hurled through the air at a velocity of 2800 ft. a second and falling at ranges up to 52,000 yd. (29.5 miles) exactly on the calculated target has brought forth the highest praise from all who observed their work, and from no less authorities than General Mangin and even General Foch.

Graphical Study of Screw Threads

By Capt. H. M. Brayton

Screw threads were among the early methods employed for holding machine parts together. Much science has been brought to bear upon this branch of engineering, and the result has been that a large number of threads have been designed for special purposes. It soon became apparent that some sort of standardization was necessary so that screws made in one shop would interchange with those made in another. As a result of the demand for standardization many civilized

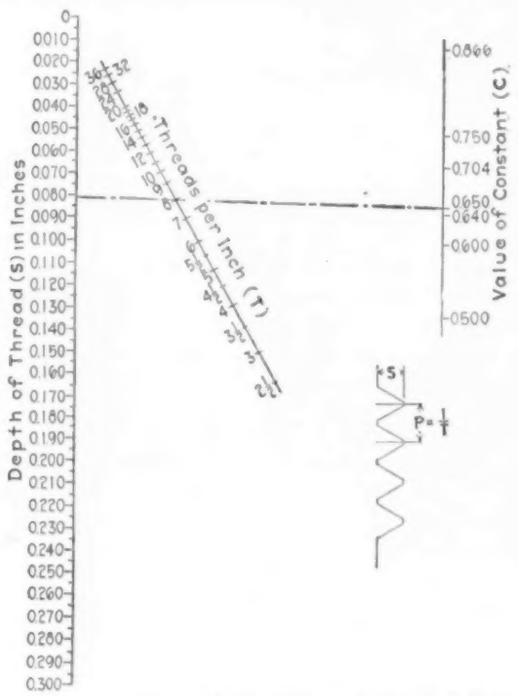


FIG. 1. CHART FOR DEPTHS OF THREADS

countries have adopted some form of screw thread, each standard differing in the various countries to a marked degree. The United States adopted the United States Standard; England the Whitworth thread, while countries on the continent of Europe selected the metric thread.

In the design of screw threads two important factors must be borne in mind—the strength of the thread and the ease of manufacture. A screw thread should be equally strong in shear, bending and tearing of the shank along the root diameter. Rules have been formulated giving the proper relation between the outside diameter of the bolt and the pitch of the thread to give the maximum of strength to the bolt.

It often happens however that a finer or coarser thread is desired for a special purpose, and in order to get the depth of the thread or the root diameter it is necessary to go through a rather tedious calculation. This depth of thread is often desired in the shop and in the drawing room. An example is when it is desired to tap a hole with a certain thread of a given diameter. The machinist desires to know the size of the drill he must use to give him a hole slightly larger than the root diameter of the thread on the tap. The designer needs to know again and again in the routine of his work what the depth of the thread is to be which he desires to

specify. If this happens to be an odd thread it will take much of his time to figure it out or look it up in a table, if he happens to have one at hand.

Fig. 1 shows a chart built up to solve at once the depth of any of the ordinary threads of domestic or foreign design. The depth of the thread is always a function of the pitch or the number of threads per inch. This function will vary only by a constant in all of the different designs. We may therefore write

$$S = \frac{C}{T} = C \times P$$

where S = depth of thread in inches;
C = a constant which depends on the design of the thread;
T = the number of threads per inch;
P = pitch of thread in inches.

The constants for the different threads listed are as follows:

	Value of constant
V-thread	0.866
Buttress or breech and German Lowenherz thread	0.750
International Standard thread	0.704
United States Standard and French metric threads	0.650
Whitworth thread	0.640
British Association Standard thread	0.600
Round, square and Acme threads	0.500

The sketch of the thread in Fig. 1 is self-explanatory.

is in knowing the depth of the thread. The chart shown in Fig. 2 enables one to read off at once this root diameter for any of the thread designs listed above. We have here to consider the outside diameter, the root diameter, the threads per inch and the constant which was used for finding the thread depth. This relation is:

$$D - d = \frac{2C}{T} = 2\,C \times P$$

where D = the outside diameter of thread in inches;
d = root diameter of thread in inches;
C = the constant;
T = the threads per inch;
P = pitch of threads in inches.

This chart is read by two lines perpendicular to each other as shown by the two dash-dot lines on the chart. The key shows how these variables are to be connected. In the illustration the constant has been taken at 0.704 and the threads per inch at 20. When these two factors are connected and a second line drawn perpendicular to this first line through the outside diameter of 0.25 in. it will cut 0.180 in. on the bottom scale, which is the root diameter. It is not necessary to draw these lines, but simply draw two perpendicular lines on transparent pa-

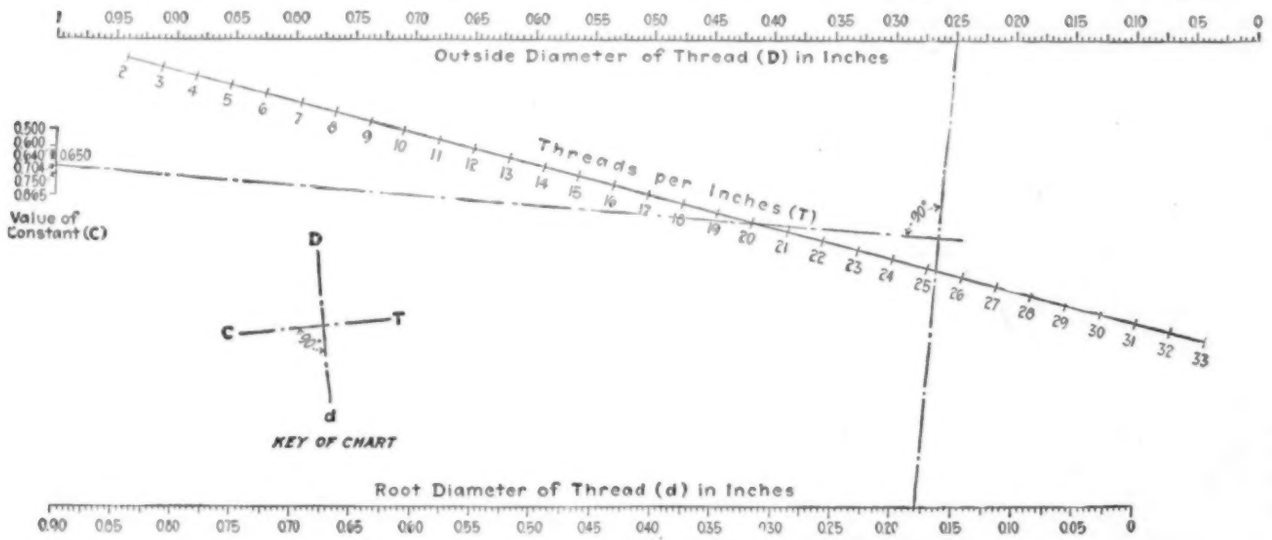


FIG. 2. CHART FOR ROOT DIAMETERS OF THREADS

To use this chart for obtaining the depth of any of these threads draw a straight line across the chart connecting the constant which applies to the thread under consideration with the number of threads per inch. This line continued will cut, on the left-hand scale, the depth of the thread (S). It is not necessary to draw this line, but simply lay on a straightedge.

An example has been taken on the chart as shown by the dash line in which the constant has been selected as 0.650, or that corresponding to the United States Standard and metric threads, and the threads per inch taken at 8. It will be noticed that this dash line continued cuts 0.081 in. on the outside scale. This is the depth of this thread. A feature of this chart is that the scale can be read within very close measurements. A designer can use this chart to good advantage and the practical shopman will find it an aid in explaining his screw-thread problems.

The shopman however is usually more concerned in knowing the actual root diameter of the thread than he

per and read the chart with this paper. Great accuracy is possible on this chart.

No consideration is here taken of the clearance that it is always necessary to allow in selecting a drill from the tap size. The amount of clearance varies for different classes of work and on different diameters, and this must be added to the root diameter read from the chart in order to give the proper drill size.

Repairing Celluloid Triangles

By P. P. Fenaux

In these days of the "high cost of drafting instruments" the following kink may be useful to those who drop their celluloid or composition triangles on the floor with disastrous results.

Clean both sides of the break with ether or alcohol, then coat with acetone, press together and clamp until thoroughly dry (one hour or so). Clean and smooth the break and the tool will be as good as new.

Extracts from Chordal's Letters

In this letter Chordal tells something about inventions and refers to a previous letter in which he wrote of two inventions that came to naught. The inventions told about in this letter are ones that have been outclassed or have lost out. Neither of them was accidental. They were the result of close application, study, hard work and perseverance. One received almost instant and world-wide recognition while recognition for the other was delayed years.

MR. EDITOR:

IN A late letter I told you something about Jimmerson and his two inventions, one of which became outclassed by something better before it got fairly going and the other of which lost its reason for existence because its product went out of fashion. Jimmerson was able to very promptly put his two inventions on the shelf and forget about them.

* * * But there are inventions which do not get promptly outclassed and which do not go out of fashion, and some of these inventions receive prompt recognition and others require years for recognition.

* * * For instance, Wilbur Wright and Orville Wright, two young inventors of Dayton, Ohio, received a prompt recognition. They invented the flying machine. It was no mere piece of luck which fell their way, for they were hard students. When they got the flying-machine bee in their bonnets they proceeded to master the literature of the art, an art which had been dallied with without success for centuries. They read all of the books and mastered all of the formulas and they tried experiments, and even went down to Kitty Hawk, N. C., where the winds blew favorably, and they tried their experiments there and found that they were misled by the books and they had to make over again many of their formulas.

* * * They left Kitty Hawk in disappointment, and went home doubting if they would ever resume their experiments. This was at the end of 1901, but the fall of the year 1902 saw them back in Kitty Hawk with a new machine, and in that year they flew, and today there are many thousands of flying machines in existence and there is a whole army of trained aviators who are flying these machines.

* * * Even at the beginning of 1911 Mr. Maxim and Mr. Hammer, writing in the World Almanac, said: "There are at least one thousand men flying today in heavier-than-air machines, whereas until the latter part of 1906 there were but two men who could fly, Messrs. Wilbur and Orville Wright, of Dayton, Ohio." But the point to be noted is that these two inventors received recognition with reasonable promptness.

* * * In 1907 the two inventors were tendered dinners and receptions by the Aero Club of the United Kingdom; by the Aero Club of America; by the Ohio Society of New York; by the Cosmos Club of Washington; by the Aero Club of Washington; by the Aeronautical Engineers' Society of Berlin; by the Aero Club of France; by the Aero Club of Rome; by the Aero Club of Sarthe, France, and by the Aeronautical Society of Great Britain.

* * * In 1908 the Aero Club of the United Kingdom awarded them gold medals inscribed, "For their pioneer work." In 1908 the Society for the Encouragement of Aviation awarded them gold medals. In 1908 the Aero Club of America presented them gold medals with a resolution expressing the club's "felicitations on their great achievement in devising, constructing and operating a successful man-carrying dynamic flying machine." In 1908 the Aeronautical Society of Great Britain presented them with gold medals, "in recognition of their distinguished services to the science of aeronautics."

In 1908 the Smithsonian Institution awarded them the Langley medals "for advancing the science of aerodromatics in its application to aviation by their successful investigations and demonstrations of the practicability of mechanical flight by man."

In 1909 the Aero Club of Sarthe, France, presented them with a bronze group inscribed "Like bird. The muse of aviation showing to the first birdmen the secrets of flying."

In 1909 the French nation awarded them gold medals and made them chevaliers of the Legion of Honor.

In 1909 the Academy of Sports of France awarded them gold medals inscribed, "The two conquerors of the air who were the first to fly with a machine heavier than air driven by a motor."

In 1909 Congress awarded them gold medals inscribed "in recognition and appreciation of their ability, courage and success in navigating the air."

In 1909 the Legislature of the state of Ohio awarded them gold medals.

In 1909 the Academy of Sciences awarded them gold medals.

In 1909 the city of Dayton, Ohio, presented them with gold medals "In recognition and appreciation of their success in navigating the air," and they were also presented with the keys and the freedom of the city of Dayton.

In 1909 the city of Le Mans, France, presented them with gold medals.

In 1909 the International Peace Society awarded them bronze medals.

In 1909 the Royal Technical College of Munich, Bavaria, conferred upon them the degree of Doctor of Technical Science "in acknowledgment of discoveries, advancement and elucidation of rich consequence in the problems of flight."

Colleges conferred on them the degree of LL.D. and they were made honorary members of the Aero Club of America, the Aeronautical Society of America, the

Aero Club of the United States, the Aeronautical Society of Great Britain, the Oesterricheschen and the Flugtechnischen Vereines. The International Aeroplane Club of Dayton, Ohio, "in recognition of valuable contributions to the science of aerial navigation and conspicuous achievements in demonstrating the practicability of the airplane," and the Society of German Aeronautical Engineers presented them with a diploma "in acknowledgment of their pioneer services in the advancement of the techniques of flight."

* * * The world was not long in recognizing the fact that these men had done something. One day, long before we thought of war, I asked Wilbur Wright if he and his brother had ever given any thought to the military aspect of the invention and he answered that the use of the flying machine for war purposes had been one of their main thoughts, as it would open up possibilities of observation which might change the course of war. Poor Wilbur Wright died before the United States entered the war, but after the European war began he expressed himself in holy horror at the ungodly use to which their invention had been applied. It is to be observed that in 1909 the International Peace Society had awarded them bronze medals.

* * * This reminds me that the two brothers were really team workers. If you asked Wilbur Wright about some point in flying-machine construction he would answer, "I would want to consult with my brother Orville before reaching a conclusion on that subject," and if you would consult Orville Wright about some point in flying-machine construction he would answer, "I will have to see my brother Wilbur about that."

* * * Another side of the question of recognition comes to me. One summer day in the late seventies I was lying on the grass with George H. Corliss on the terraces in the shop yard, and he had been reviewing to me the history of the Corliss engine. He said to me, "Mr. Chordal, do you know anything about the Montyon prize?" I answered that all I knew was that it was a prize given in France for extraordinary accomplishments. He gave a peculiar sort of a whistle and a boy sprung out of the office and Mr. Corliss said, "Boy, Mr. Rainsford." Mr. Rainsford was, I believe, the secretary of the company and was Mr. Corliss right-hand man. Mr. Rainsford came out of the office and Mr. Corliss said, "Mr. Rainsford, the Montyon prize." Mr. Rainsford went to the office and returned with a formidable-looking engrossed parchment which he handed to Mr. Corliss and then departed. Immediately there was the whistle, and the boy, and the order, "Boy, Mr. Rainsford." Rainsford approached and Mr. Corliss said, "Rainsford, the bag of gold." Mr. Rainsford disappeared into the office again and came out and approached us with a chamois-skin bag full of gold and hied himself to the office again. Then Mr. Corliss handed me the document and the bag of gold and said, "Mr. Chordal do you read French?" I answered that I did not, and there was again the whistle, and again the boy, and again the order, "Boy, Mr. Rainsford." Mr. Rainsford again approached and Mr. Corliss said, "Rainsford, translate this for Mr. Chordal."

* * * The document was an award to George H. Corliss for some masterly invention advancing the mechanical arts. Mr. Corliss untied the bag and dumped the gold into my hat and we took a good look at it and then he put it back in the bag. He asked what I thought of it and I said that I thought well of it and I hoped that I would live long enough to have something of that kind said about me. Then he said, "Look at the date. Do you know when I got up my engine?" I answered that I believed it was in about 1859. Then he said, "It has taken that French Society 20 years to find out that I have done anything." He whistled again; the boy approached. "Boy, Mr. Rainsford." Mr. Rainsford approached, and Mr. Corliss said, "Rainsford, take the Montyon prize away."

Very respectfully,
CHORDAL.

French Women's War-Service Costume

The costumes for women workers, herewith shown, will no doubt interest those employing or about to employ female help. This is the type of dress that is

FRENCH WOMEN'S UNIFORM

worn by the women in the National Projectile Factory of France.

The group is a mother and her two daughters. Incidentally, it may be stated that they are all capable machine operators and are now working on American-made Gisholt turret lathes, which should convince those who are hesitating that it is possible for women to operate the heavier types of machine tools as well as the lighter ones.

Present Practice in Thread-Gage Making*

By FRANK O. WELLS
President of the Greenfield Tap and Die Corporation, Greenfield, Mass.

Many difficulties are experienced by manufacturers of thread gages in their efforts to maintain accuracy and standardization and at the same time meet the demands of increased production. The process of cutting threads in the lathe requires expert manipulation. Errors in the lead screw should be corrected and a good cutting tool correctly held is essential. Approved methods of thread lapping, grinding and testing are described. The question of tolerances is important. Unreasonable and useless accuracy of gage tolerance complicates the making and increases the cost of thread gages. The author recommends a set of values for medium tolerances. The figures are not too close and are offered as applicable in most practical cases.

THE manufacture of thread gages brings in all the difficulties of any thread product multiplied according to the degree of accuracy required. The usual methods of making threads must therefore be refined and improved, and at the same time standardized for manufacturing purposes. The maintenance and development of good methods of gage manufacture are also affected by the same disturbances that affect all manufacturers these days, including unevenness in steel material, delays in shipments and in machine arrivals after orders are placed, and, most of all, difficulties with labor.

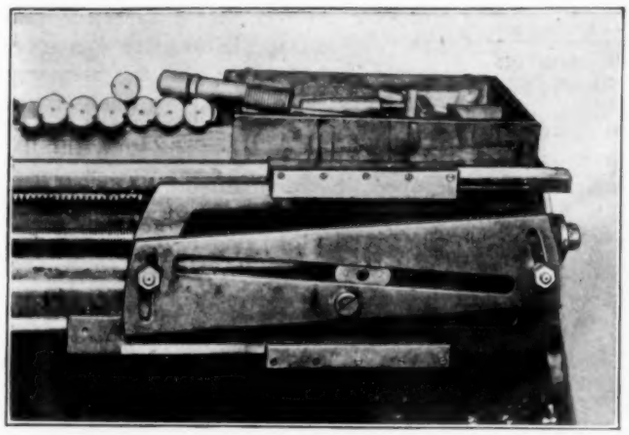


FIG. 1. LEAD-ADJUSTING ATTACHMENT FOR LATHE

To maintain and even to increase the accuracy and standardization of product, as is specially demanded, is no easy task, but it is being done by paying careful attention to the troublesome points.

Given the blank for a thread plug gage, centered and turned, the real trouble begins with chasing the thread. A lead screw should be as accurate as the product to be turned out by it. Errors in lead screws are of two kinds—errors in lead over a considerable length of the screw, and local errors from thread to thread. If, as is often the case, the lead screw was made from ordinary work instead of for precision work its lead or pitch will be irregular to a greater or less extent. The total deviation of the lead screw must then be determined, and the lead-adjusting attachment, Fig. 1, set to give the correct compensation.

The thread cut on a soft gage must always be slightly different from standard or finished pitch by an amount equal to the expected change during hardening. This correction must also be made by the lead variator.

Adjusting attachments like that in Fig. 1 compensate fairly well for errors in the lead screw which are constant at any part of its length. They do not, however, take care of the trouble of "high and low" threads. In lathes used for thread-gage chasing the lead screw ought to be well-nigh perfect from thread to thread, and the ways of the lathe should be scraped accurately parallel and level so that the head and tail centers will be in line.

Given a fairly good lead screw the next mechanical necessity is a good cutting tool correctly held. Such tools, with removable cutting blades, are shown in Figs. 2 and 3, one for inside and the other for outside chasing.

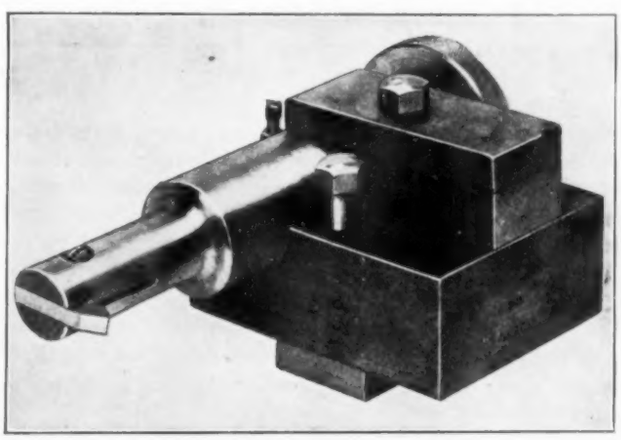


FIG. 2. TOOL FOR INSIDE CHASING

It is a question whether a single cutting tool or a multiple-toothed chasing tool is better for this work. The fixture for grinding the cutting points is also shown in Fig. 4.

The threading-tool blades in Figs. 2 and 3 are made to cut on a 20-deg. clearance angle. This clearance angle makes the actual included angle of the tool blade normal to the straight cutting edge of the tool blade 63 deg. and 8 min. The thread groove cut by a proper threading tool should preferably be from 15 to 30 min. sharp in order to facilitate the lapping operation. For all ordinary United States Standard pitches the threading-tool blade is set with its axis at right angles to the axis of the gage. It is only for Acme or similar very coarse thread work that it is necessary to incline the

*Presented at the annual meeting of the American Society of Mechanical Engineers, in December, 1918, at 29 West 39th St., New York.

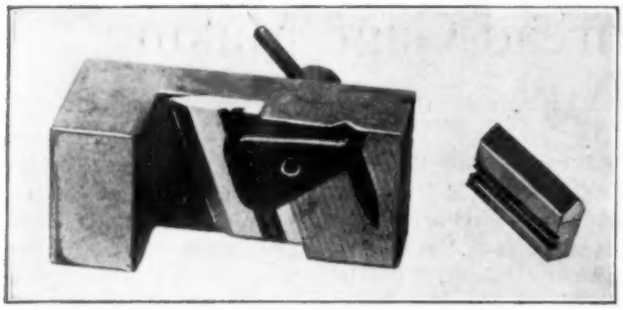


FIG. 4. FIXTURE TO SHARPEN TOOLS USED FOR CHASING

threading blade to a line parallel to the helix angle of the gage being threaded. When this helix angle is very steep it is necessary to modify the included angle of the cutting edge so that the angle cut on a plane with the axis of the gage will be as required by specification.

A clearance channel is universally acknowledged desirable in a thread gage so that no chip lodging in the gage will bind between the gage and the thread crest of the tested thread and give a mistaken impression of a close fit.

There is great difficulty in getting men who are good at threading. Good threaders seem to be born, not made. The work requires a combination of brain, mechanical ability, sensitive touch and, above all, patience. Some otherwise good mechanics can never make good threaders. A green man with a phlegmatic temperament is a likely candidate for development. Few girls can be developed into handling fine threading—it requires just a little more mechanical sense than any appreciable number have had time to acquire. The Government should be careful about taking men from gage-threading lathes, especially when on the same day another branch of the Government may send an urgent appeal to increase or even double the production of gages.

FIG. 3. TOOL FOR OUTSIDE CHASING

With good men, fair lathes, the best cutting tools and the exercise of constant care, threading of gages down to a limit of accuracy which falls within the variations due to hardening can be accomplished. If a perfect contour of thread and perfect angle, lead and walls could be obtained when threading in a lathe it would not be necessary to leave more than 0.0002 to 0.0006 in. over size, knowing that hardening would increase this to from 0.0015 to 0.0020 in. Due to irregular swelling, shrinking and warping from thread to thread in the hardening, however, a certain amount of stock must be left on so that no point of the gage will be distorted outside of the limits of the metal. If the thread, for instance, should take a quirk to the right so that its center line was displaced at the top of the crest by 0.0009 in. and the metal had been left 0.0015 in. larger than finished size the reduction to finish could be made and still leave a complete crest. Since a margin must be left for the vagaries of hardening, the necessary tolerance in lathe threading can probably be obtained by the precautions noted.

Formerly it was common practice to make the outside diameter of limit plug thread gages uniformly oversize in direct proportion to the oversize of pitch diameter. This practice was wrong because of the danger of the maximum, or no-go, plug forming contact on the outside diameter of the tapped hole and yet giving no indication of the actual size of hole on the pitch diameter or the thread walls.

In view of the go and no-go plugs being over basic, or maximum, screw size they should both be provided with a minus tolerance below the minimum tapped-hole outside diameter in order that the gage will positively check the angular diameter. This can be done, since there is no danger of the screws forming contact with the outside diameter of the tapped hole.

Manufacturing Government or priority war orders marked "Rush" entails some trouble in that the orders cannot be scheduled in the most efficient, sensible and, in the end, speediest way. There is really no reason why all orders calling for the same outside diameter and same length over all should not be grouped in turning, and in this way enable the operator to run enough blanks through so as to cover the orders for various pitches. Again, in the thread-lathe room gages of the same number of threads per inch, but differing by one or two thousandths in pitch diameter, could be chased out as members of the same group. They could be run through with one setup of the lathe and save on the average 30 per cent. of the cost of the same orders ungrouped. Since small similar orders like this, varying only by differentials, constitute about half of the output of the gage factory such a grouping would save about one-sixth of all of the expense of the department as conducted under present methods.

The reason that this cannot be done now is that when a rush priority order for say two $\frac{3}{16}$-in. 24-thread gages comes in it has to be routed, started, put through

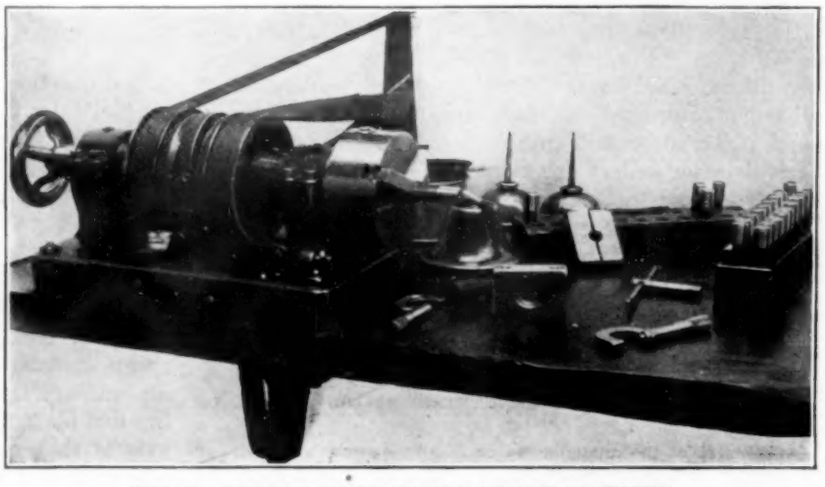


FIG. 5. THREAD PLUG GAGE LAPPING MACHINE

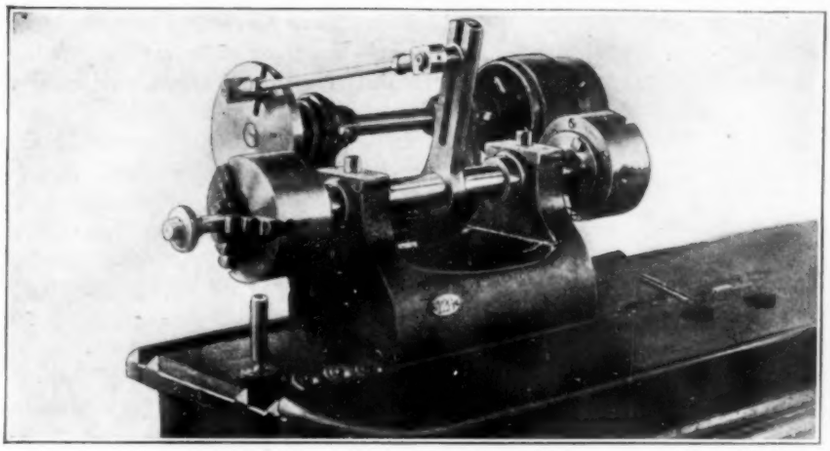


FIG. 6. DOUBLE LAPPING MACHINE

and finished at once. Then, if the next A1 priority order is for eight pieces of 3-in. eight-thread gages, these must immediately follow, without waiting for another small size which might be done with the same setting of the lathe and which perhaps is equally important but which happened to come in a little later. If a batch of the same size were put through all at once so much time would really be gained that the succeeding orders meanwhile sent in by the Government would be done considerably sooner in the long run and the Government be much the gainer in aggregate time.

Accurate micrometers or gages should be constantly used over all parts of the thread while in process, and accurate lead testers and gages should be constantly on hand in the workroom itself.

The hardening question has always been the bane of threading. A series of tests made some time ago by laboratories of manufacturing firms throughout the country demonstrated that threading on taps and dies can be got down to any reasonable limit of accuracy, but this is not true of hardening. The inaccuracies in taps and dies manufactured by quantity methods in general appear after hardening and are not present in the soft product. The same is true of gage threads, only the error in this case is of more importance on such fine work.

During the process of hardening there is in the majority of cases an increase, or swelling, in diameter and a shrinkage in length, resulting in a shortening of lead, but the extent to which this occurs will vary in different pieces. Even with the quenching bath and the temperature of the furnace kept uniform the swelling in diameter in one set of duplicate samples of about an inch in diameter varied from 0.0008 to 0.0024 in. and the lead error varied from 0.0005 to 0.0025 in.

The only way to control this is to find a heat treatment and a quenching bath that will always give the same expansion and contraction under standardized methods of working and dipping, then see that the handling methods actually are standardized. And not only must uniform handling methods be followed, but the steel must be of uniform quality. For this reason it is necessary to have a supply of steel from which any piece may be taken and relied upon to act like every other piece. If such steel cannot be secured from the steel men it is advisable to get the most uniform brand available and then standardize it still more by heat treatment.

In general the best hardening method adaptable for gages can be described as follows: Ascertain the lowest heat which will give the proper depth of carbonization in a reasonable time; next ascertain the heat at which the gage will properly harden upon quenching and maintain these two features within the closest possible limits of uniformity. What has been said previously regarding the brand of steel will remain true.

If the lathe work has been done correctly and the hardening without distortion the thread can be smoothed to a finish by lapping off not much more than 0.0002 in. Under ideal conditions this would be the amount of oversize that would be specified for gages coming into the lapping room. A much neater and quicker job of cleaning the thread to size could then be done, and the cost of lapping would go down.

However, not only excessive oversizes but distorted pieces come into the lapping room. The lapping process can to a certain extent take out these inequalities as well as smooth the surface of the chased thread. It should be emphasized that the lapping process is not for this purpose and that every correction that has to be made in the lapping costs excessively and slows up

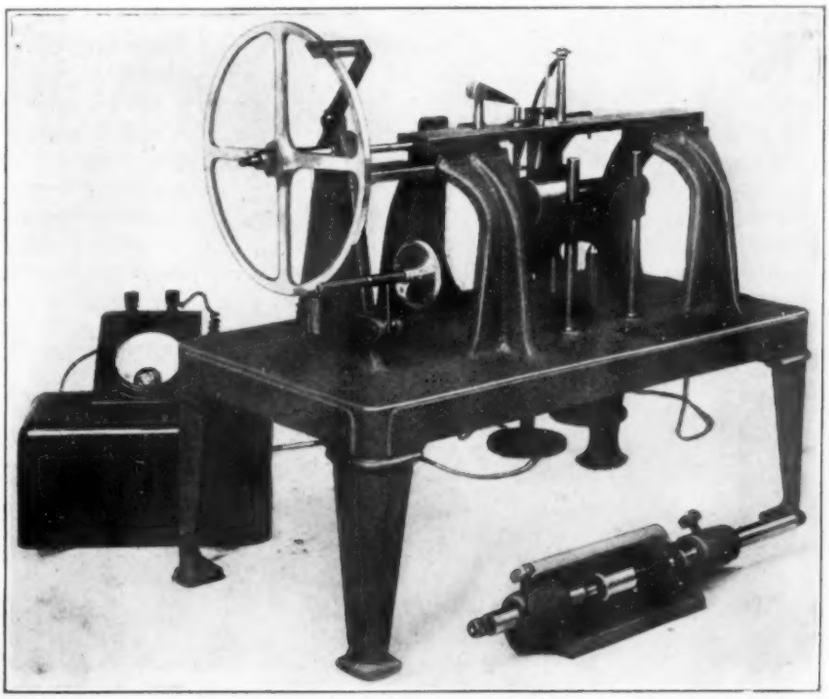


FIG. 7. BINGHAM-POWELL LEAD-TESTING MACHINE

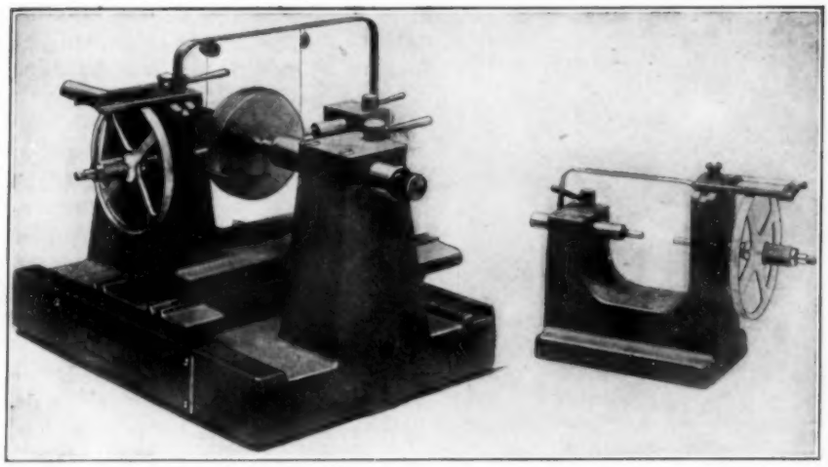


FIG. 8. MACHINE FOR TESTING PITCH

the other work. Lapping should not be depended upon to do correcting, but the threading should be in correct shape before reaching the lapping room.

If the angle of the thread is slightly too wide or narrow or tipped to one side a skillful lapper can correct it. If the lead is a trifle too long or short the lap can take it back to the proper length by wearing the surface off on one side or the other of each thread. If the pitch diameter is too large it can be worn down. But there is a limit to the amount that can be worn off by hand-applied friction, using the general form of thread as a guide, and still retain an accurate contour. It is practicable to take off a total of 0.0015 by lapping without spoiling the shape if it is done carefully on only one gage. Therefore, allowing part of the overstock for smoothing, if the errors are not cumulative or all in the same direction it is possible in lapping out 0.0015 in. oversize in diameter to take care of an error of 0.0005 in. in lead and 15 min. one way or the other in the angle.

Two forms of lapping machine for thread plug gages are shown in Figs. 5 and 6. In the best plug-lapping machines the plug is mechanically rocked back and forth through a fraction of a revolution while the operative holds the lap still in one hand, encircling the plug. Since the operative might as well be using both hands a double-ended machine is provided, Fig. 6.

Soft-steel laps are most easily chased out smoothly and are the most durable. Some prefer cast-iron laps, however. The lap is an important part of the work and must be threaded more accurately than the gage which it is to correct. Flour of emery makes the most satisfactory lapping medium for thread gages, particularly for lapping the thread walls. Fifteen-minute carborundum is satisfactory for lapping outside diameters. Sperm oil makes the most satisfactory medium for carrying the abrasive, chiefly because of its non-gumming quality and at the same time having more body than kerosene which is quite commonly used. As a thread gage can be no better than the lap which finished it, it stands to reason that laps must be made as accurately as possible; therefore to get the most use out of a lap the threaded work that is ultimately to be lapped must also be made accurately. It is not profitable to leave any more corrective work for the lap to do than can be avoided. As the lap is of soft material very little pressure applied in a false direction will be sufficient to ruin it. Girls may be used on lapping if those with level heads and the requisite sense of touch are selected.

Inspection instruments, including a sufficient number of gages, a projection apparatus, and micrometers should be on hand in the lapping room for the use of all employees, who should be trained to use them and to interpret the measurements.

Grinding out inaccuracies in large-sized threads is more expeditious and cheaper than lapping them out. Grinding threads becomes difficult, costly and impracticable, however, below a certain minimum size, in general, for the following reasons:

In grinding out a V-thread as near as feasible down to the theoretical triangular point, as is done in thread gages, there is intensified friction on the delicate edge of the wheel, and it wears away very quickly. It could not be used at all were it not that the extreme edge of the wheel does not have to be maintained absolutely sharp.

On all practicable manufactured screw threads upon which the gage is to be used, whether United States Standard, International or Whitworth, at least the top eighth of crest is flattened or rounded off. Therefore, although the profile of the gage thread must be kept accurately straight along seven-eighths of the wall, the remaining eighth in the extreme root can be allowed to become a little rounded off, since it will not engage any

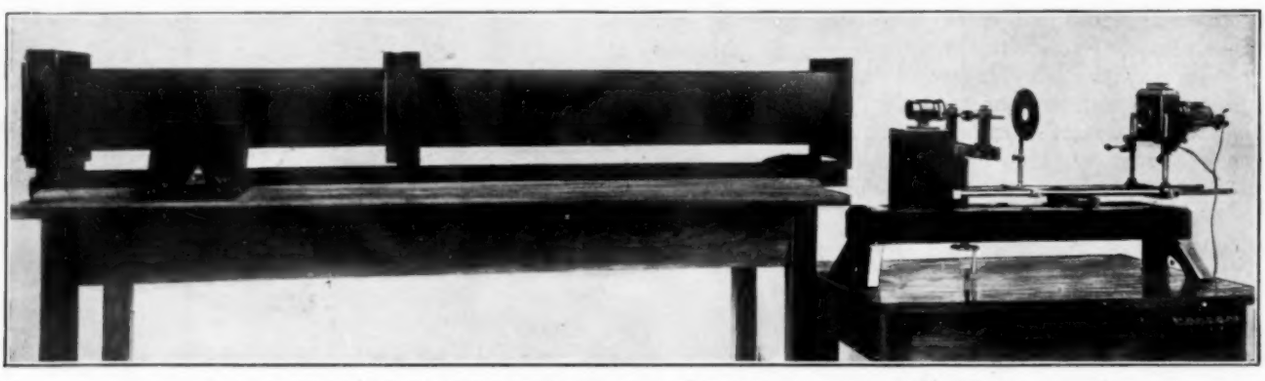


FIG. 9. PROJECTION LANTERN FOR CHECKING SILHOUETTE OF THREAD

FIG. 10. PROJECTION MACHINE FOR CHECKING CONTOUR OF THREAD

part of the thread, but will be used as a clearance space. Now an eighth of a large pitch on a large diameter gives the wheel edge considerable margin for wear. The absolute length of this margin decreases toward the point in proportion as the pitch from thread to thread decreases, and soon the point is reached where the allowable eighth margin at the edge of the wheel wears away too fast for practicable replacement of wheels. One wheel should do at least one complete gage before needing to be trued at all, since the wheel cannot be taken out and put back in the same place with any success. This margin of wear on the wheel is now generally reached at a pitch of 16 threads to the inch, so that most gages below $\frac{5}{16}$-in. pitch diameter have at present to be lapped out instead of ground.

There are other difficulties in the way of grinding small threads. On the average the best thread-grinding wheel is about No. 150.H, as we find in our own work. For the grinding process from 0.003 in. to 0.008 in. of stock should be left on a thread gage to enable the operative to set his wheel in the center of the thread by adjustment and trial and also to permit him to correct inequalities in lead, angle or diameter due to hardening.

Out of 0.003 in. of stock he can increase or decrease the lead by 0.001 in. if the angle is already correct. Similar corrections in the other dimensions may be effected. Work coming from the grinding room is then lapped smooth before it goes to the inspection room.

Inspection in gage manufacture assumes an importance that it has in hardly any other branch of work. This is still more true of thread gages. The many dimensions that are on an apparently simple product require close attention to each separately and to all together.

To test the lead the Bingham-Powell machine is a good instrument. The method of holding the gage, the micrometer wheel and vernier and the electric telltale that indicates proper contact of the measuring fingers and the thread are shown in Fig. 7.

A testing machine fitted up with a slide rest in parallel so that only two wires are necessary is good for measuring pitch diameter by aid of a micrometer reading. This machine is provided with two removable tables, one for large work and one for small, Fig. 8. To test the micrometer a set of Johansson blocks should be on hand, and finally to resolve immediately any doubts one might have as to the accuracy of a particular block or measurement a good measuring machine should be on hand. Tenths and hundredths of thousandths are elusive things, almost imaginary, impalpable and invisible. A man traveling down among them and coming upon any doubt in his own mind as to his exact location is like a man lost in a wood, and it is necessary to follow the old prescription of wise travelers to always carry two compasses or two watches. If one is assailed by a sudden doubt that one may be wrong, look at the other. If they both say the same thing, one feels that it is a million to one that they are both right and he can go ahead.

To examine the contour of the thread, its angle, root, crest and smoothness of wall a projection machine, Figs. 9 and 10, is the only proper thing. It gives an enlarged silhouette of the thread, which speaks for itself, for the profile can be compared with pattern gages held upon the screen as in the illustration. The silhouette can also be photographed for transmission to a customer by inserting a film or plate instead of the ground glass. Mechanism is provided for holding the gage, for focusing it and for turning it to the helix angle so as to get a symmetrical projection of the walls.

Sulphur casts of female threads can be taken in quick time and at small cost, and the contour examined in the same quick way. The method of pouring the melted sulphur into a molding frame held against part of the thread so as to get enough of it to give contour and lead is shown in Fig. 11.

A great difficulty in the manufacture of thread gages is the unreasonable and useless accuracy of gage tolerance and wear allowance sometimes requested by purchasing firms. When a tolerance of 0.0002 in. is set on a gage specification it should mean that the cus-

FIG. 11. MACHINE FOR INSPECTING FEMALE-THREAD TOLERANCE ON GAGES

tomer's tolerance on product is as close as 0.001 in. If the purchaser's manufacturing tolerance is any broader than that there is no use in keeping the gage so close. A 0.0002-in. error would be lost in the comparison. In order to facilitate the making and to lessen the cost of thread gages it is well to allow quite liberal tolerances in their manufacture, and we recommend the following as being applicable for most cases where medium tolerances are allowed on product: From 4 to 6 pitch allow a tolerance of 0.0006 in.; from 7 to 18 pitch allow a tolerance of 0.0004 in.; from 20 to 28 pitch allow 0.0003 in.; from 30 to 80 pitch allow 0.0002 in.

Checking the Effective Size

The foregoing applies to master gages. For inspection gages the tolerances would be slightly wider, and would begin where the master inspection gage tolerances leave off. These would be as follows: From 4 to 6 pitch a tolerance of 0.0009 in.; from 7 to 10 pitch, 0.0006 in.; from 11 to 18 pitch, 0.0004 in.; from 20 to 28 pitch, 0.0003 in.; from 30 to 40 pitch, 0.0003 in.; from 44 to 80 pitch, 0.0002 in.

All of the foregoing tolerances would be applied plus in the case of go male gages and no-go female gages, and minus on no-go male and go female thread gages.

The plus and minus tolerances given apply to pitch diameters of all thread gages and also to root or core dies of templets or female thread gages.

The maximum, or go, templet gage represents the maximum or basic screw, and its manufacturing tolerances should be minus on pitch diameter and root diameter. The minimum, or no-go, templet should be made to plus tolerances with an extra plus allowance on the root diameter, which will insure this gage really checking the effective size of the screw.

There is no need for a manufacturer to require every gage made to the finest point possible if he would not want to hold himself to the corresponding tolerance in his own product. People sometimes do not stop to think that to measure down to 0.0001 in. one must use exquisite care as to cleanliness, vibration and control of temperature between master and part. A change of a few degrees in temperature, etc., will add a couple of tenths to a fairly small piece without warning.

The wear and adjustment tolerance on a gage should be coarse or fine on a sliding scale according to the manufacturer's tolerance on his product. If a tolerance of 0.0002 in. is really necessary, all well and good; but if it should not be necessary it slows down gage production too much to be at all popular.

An Improvised Tumbling Barrel

By E. Amos

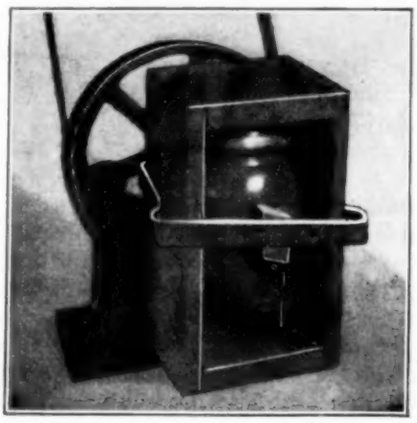
On a recent expedition in search of ideas the writer (to whom ideas do not come naturally as to some more fortunate individuals) saw what to him was a new departure in the way of tumbling "barrels."

A part of a certain shop's product is comprised of small pins, studs and special rivets which are made principally on automatics, these pieces being afterward tumbled in sawdust for the double purpose of cleaning them and of removing any small burs and ragged edges that may be left by the cutting tools.

Because of the small size of the parts it would be impracticable to use any commercial size of tumbling barrel, as a lot of 1000 or even 5000 pieces would be so insignificant in bulk as to be lost or overlooked in such a barrel; it was therefore up to the master-mechanical mind to provide a substitute, and the cut and following description show how he did it.

A pedestal that was part of a discarded machine was used, which had two bearings at the top for a small horizontal shaft. The shaft is perhaps $\frac{9}{16}$ or $\frac{11}{16}$ in. in diameter and has at one end a pulley for the driving belt and at the other a cast-iron flange 3 or 4 in. in diameter. The hubs of pulley and flange serve as collars against their respective bearings to prevent undue end movement of the shaft.

To the flange is attached, open side outward, an ordinary rectangular wooden box—not just any old



A TUMBLING "JARREL"

box, for it must be just right in dimensions, but one that can be built by anybody with a saw, a hammer, some nails and a few minutes' spare time.

The "inner chamber" of this apparatus is an earthenware crock, or jar, of the kind whose habitat is the eastern end of Massachusetts, and whose life is usually dedicated to holding "Boston baked" while in the oven. The wooden box before mentioned is made of just the right size to receive the jar without allowing it any room to move or shake about.

With the charge in the jar the latter is set in an upright position in the box, a swinging strap pivoted on the sides of the box is let down and a wooden wedge inserted to prevent the jar from working out, the belt is put on the driving pulley and the "barrel" turns merrily end over end as long as desired.

The work cannot get out of the jar, for the end of the close-fitting box keeps the cover on, and the jar cannot get out of the box as the only open side is closed by the strap and there is no real tendency for the jar to get out that way, anyhow.

To recharge the barrel, stop the box, turn the jar to an upright position, swing up the strap, take out the jar and substitute a freshly filled one. The whole thing can be done by one man in 10 sec. without even taking off the driving belt, as the latter drives directly from an overhead shaft, no pulley being needed. Simply grasping the revolving box with the left hand will cause the belt to slip while the operator changes the jar with his other hand.

Reasons for Consolidating the American Engineering Professions

By A. D. FLINN
Secretary of the Engineering Council

THE organization of engineers in America is chaotic, complex and illogical. As consequences there are confusion, waste, inefficiency and dissatisfaction, which, however, are exaggerated in some minds. If no associations existed it would be relatively easy to plan and create a system of organization that would satisfy demands much more effectively than does the present multiplicity of unrelated societies. But there have grown with the years traditions and loyalties and prejudices clustering about the societies that now are. An answer to the problem thus created is not easy. To me the solution is not obvious, but some progress in the process is now appearing. There must be extensive consolidations, more federation and much simplification, each of which demands elimination. Steps are being taken, or preparations made for them, in various ways and places and by a number of agencies. They will be accelerated as their benefits gain appreciation; but education, time and patience are needed for attaining the goal.

The Problems Confronting a Consolidation Scheme

What are the present desirable limits to consolidation and federation? To what goal should they tend? By what methods and means can they best be brought about? These and similar questions are not being answered conclusively because the necessary facts are not in hand. We have been muddling along in an unengineering fashion, attempting to plan and design and specify without a survey. On Sept. 12 Engineering Foundation by formal vote proposed to make the much needed survey and preliminary studies, the four Founder Societies concurring. Of the necessity for this survey I have been more deeply convinced with the passing weeks, as I have listened to ineffective arguments and to misstatements based on ignorance which can be corrected only by the results of the proposed survey of engineering organizations.

Without the enlightenment of such a survey it now seems that the following elements of organization are desirable for the engineering profession in America: Excepting possibly three or four cities having large numbers of engineers there should be in each community having a sufficient group of technical men to be organized one organization that embraces them all. Reasons for this are obvious. This organization may be an association of local societies and sections of national societies or it may be a society admitting to its membership men of all branches of the profession. Examples of both forms of organization exist in a number of places. Local organizations should have large measures of autonomy, but should conform to approved types and standards.

Logically the next step in organizing would be the combining of these local organizations into one or a few national societies, so that the loyalty, interest, comradeship and activities naturally developed by the local organizations would flow to the national societies. But at this step the difficulties increase. Many engineers cannot become active members of local organizations because of distances from headquarters; others do not desire local membership. If there were only one national society many of the difficulties of scheming a system of organization would disappear, but there are, and probably for some years will be, several national societies of importance, and in each local organization there will be members of two or more national societies. A number of plans have been submitted to me for overcoming these difficulties. None is wholly acceptable. These problems lie at the bottom of the tasks of the committee on development of the American Society of Civil Engineers and of the committee on aims and organization of the American Society of Mechanical Engineers and similar committees which may be appointed by other societies. Many engineers are giving them earnest thought.

There are said to be approximately 400 organizations of engineers in America of various kinds. Of these about one-quarter are the leading national societies and their local sections. In general the remaining societies have no official relationship, excepting the associations of local societies and sections in a few communities. Consequently the engineering profession, before the public and Government, has no one organization which represents it as a whole, as have the medical profession, the lawyers, the chemists, the architects, the Chamber of Commerce and even labor. In the memberships of the Founder Societies, aggregating 35,000 engineers, there have been variously estimated to be only one-third to one-sixth of the total number of engineers in the country. The engineering profession lacks solidarity.

Engineers Have Exceptional Facilities

Not a little of the dissatisfaction voiced in various quarters as to the shortcomings of the national societies grows out of ignorance or lack of apprehension of benefits actually received. In no small measure the complainants are at fault in not making better use of the facilities provided and the means of information put within their reach. Furthermore some important benefits of membership in large technical societies are intangible and not capable of definition; not a few persons overlook these. Nevertheless there are causes for reasonable dissatisfaction. The societies are endeavoring to remove these as they are recognized and remedies can be found. Humanity and its institutions will never be wholly rid of dissatisfaction, and to this truism engineers are no exception.

In this connection a quotation from the presidential address of Charles T. Main to the American Society of Mechanical Engineers, December, 1918, is of interest.

In the *Monthly Bulletin* of the American Institute of Mining Engineers, March, 1918, there appeared the following: "The vision dwells in the minds of many that ultimately these four great societies, lightening the emphasis they place upon their differences, may see the time when,

for the solidarity of the profession, for their best interests, as well as for the increase of their influence on the country at large, they may become one great national association of engineers. With the gain in power and prestige inevitably following such an aggregation freedom for individual development may be achieved through divisions along the lines of technical interests, which might either follow the present four grand divisions or be more minutely subdivided. An organization of this sort could and probably would be more strictly professional than any of the four have been heretofore, and through the prestige and power of its numbers could establish standards of ethical conduct for its members, violation of which would bring grave consequence."

This great vision is worthy of the most careful consideration and might be carried with safety to a point where the national societies would be gathered in under one executive head, without any one losing any vital portion of its individuality. This would be a great step in advance and perhaps as far as we should go for some time to come.

Whatever scheme of organization be ultimately selected it must be flexible, so as to meet successfully constantly changing conditions, and it must provide for both technical and social requirements of the membership while maintaining high standards. "Social requirements" is here used to mean, in addition to social intercourse among members, services of the organizations to Government and to the public and services to engineers individually, such as assistance in securing engagements and better standing in corporate and governmental employment. Technical and social functions probably will be best kept distinct. Some engineers even suggest separate organizations, but at present prefer separate departments of one organization or of a federated group of organizations.

So far as known none of the leading organizations has stated a definite policy on these questions. Opinions herein expressed are only personal. The statements in this paper are merely a contribution to the general discussion of this subject by one who for several months has had especial opportunities for learning the opinions of others and gathering a little information.

The United Engineering Society

As regards the joint activities of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers the present organization seems involved, and even some members of the governing bodies of these societies have difficulty in keeping relationships straight. It is, however, not so complex as some persons assume. It may be simply stated as follows: The four Founder Societies named have joined in creating the United Engineering Society to hold and administer property and to perform other broad functions for them. At their request the United Engineering Society has established three departments, the Library Board, the Engineering Foundation and Engineering Council.

The Engineering Societies Library has possibilities for active usefulness to the engineering profession and to the industries of this country. Its present passive services are good and of great value, but the library can do much more. Funds are needed at once for complete recataloging of the books, for strengthening the collection of books and for instituting new lines of service. The books of the societies have been brought together, but they have not yet been assembled as one library. Never, except during the war, has it been so important that all useful recorded technical information should be fully and quickly accessible to engineers —not only to those in the New York district, but also to those scattered throughout the whole land.

The Engineering Foundation now has an endowment of $300,000, yielding an annual income of $15,000. It rendered vital financial assistance to the National Research Council at the latter's inception in 1916 and for the year terminating in September, 1917. That council performed services of great importance to the Government during the war. For the future it already has in hand many projects. One of the most important of these is the promotion of industrial research, in which the Engineering Foundation is coöperating. The Engineering Foundation investigated a scheme for spray camouflage of ships; is conducting long-time tests on the wear of gears, and is making a research on the selective control of wireless communication. It has offered to undertake a "survey of existing engineering organizations, and from information thus developed to formulate a series of constructive recommendations which may be serviceable in guiding the further development of local and national engineering organizations in their relations to the profession of engineers, to the public and to one another." Other projects are being studied, but cannot yet be announced. Engineering Foundation's policy is to devote its energies and resources to undertakings of broad application, such as bringing about and stimulating coöperation among existing agencies engaged in research and outlining programs and organizations for research in specific fields.

Progress of the Engineering Council

The Engineering Council, since its organization meeting on June 27, 1917, has made progress in exploring its proper field of activity and fixing some of its boundaries. It has accomplished much useful but negative work. In other words its rejections have been important and have consumed much time. But there are also noteworthy constructive achievements on the credit side of its records. During hostilities the council rendered no small aid to the Government through the American Engineering Service, which procured thousands of engineers for the War, Navy and other departments, and through the War Committee of Technical Societies, which assisted the Naval Consulting Board and the Army General Staff in examining scores of thousands of suggestions for naval and military devices. Through efforts of its public affairs committee the council aided in having the military draft adjusted to permit the continuance of training in the engineering schools of the vitally necessary technical men. Through the industrial affairs committee vigorous opposition was offered to "antiefficiency legislation" in Congress. Ten days after the signing of the armistice the Engineering Societies Employment Bureau, with the four Founder secretaries as its board of directors, was substituted for the war-time American Engineering Service. The fuel-conservation committee acted in a consulting capacity to the Fuel Administration and the Bureau of Mines in securing war economies, and is continuing its much needed services into the era of peace. The water-conservation committee is prepared to promote right, and to oppose wrong, national or state governmental actions relating to water power or other utilization of water, by supplying statements of facts rather than joining in controversial support or opposi-

tion of any particular measure. The license committee, with members judiciously distributed throughout the country, is collecting information on the licensing of engineers by the various states and is preparing to render proper assistance in these matters whenever needed. The patents committee, coöperating with other similar bodies, is preparing important action for the improvement of the patent law and practice. During the spring and summer the secretary visited groups of engineers representing the local societies and sections of national societies in 20 different cities from the Atlantic seaboard to the Pacific Coast. In 30 or more communities local correspondents have been selected for direct communication between Engineering Council and engineers at distances from headquarters. Furthermore, important projects of interest to all engineers are in preparation and may soon be announced. One of these is the formation of a national service committee, which is to have an office in Washington as the representative of the American engineers at the national capital. All aims and endeavors of engineers through their national and local societies and their joint instrumentalities must be pervaded by a sincere spirit of service, not alone of one to another but by all to the community, the state and the nation. Such public service by engineers, architects, chemists, scientists, doctors, lawyers and clergymen is our professional obligation, the *noblesse oblige* of a free and democratic people. Each profession has its distinct service to perform. In each profession there are big men and small men; each must contribute according to that which he has. Service is the only true stepping stone to that eminence which alone is worth attaining. Greater opportunities have never opened to American engineers than those which confront them in these rapidly passing years of war and reconstruction.

Unique Shell-Profile Turning Attachment

BY DONALD A. BAKER

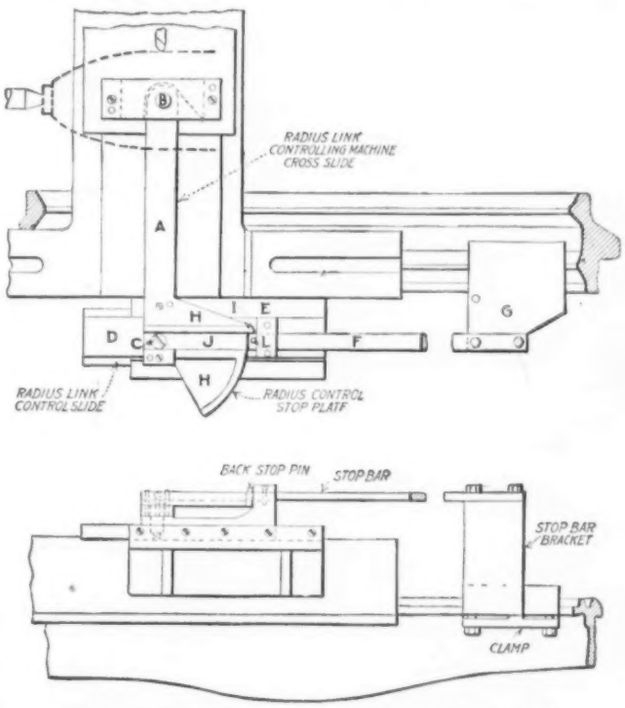
Turning the curved nose of projectiles has introduced to regular practice a feature that in the old days was seldom encountered—that of turning a radius over part of the surface to be finished, the curve of this radius running smoothly into the remaining parallel portion. Many methods have been devised for accomplishing this movement, one of which is here appended.

FOR turning the profile on the nose of large-caliber shells no regular equipment is provided for the ordinary engine lathes. It is therefore necessary for each manufacturer to provide special attachments for this work either in the form of a link of proper length for controlling the radius or of a suitably shaped cam plate. The former is to be preferred where the profile consists of a simple radius, while the latter will be necessary if the profile consists of two or more radii or is an irregular curve.

The attachment here shown is of the link type, which I believe is unique. The design was got out for a customer who desired a fixture that would start the cut at the small end of the shell, turn the radius up to the point where it joined the straight side of the shell and then turn parallel until the operator disengaged the feed.

With a link attached to a fixed member at the back of the lathe it is necessary to disengage the feed before the carriage reaches this point and finish the turning by hand up to the stop, otherwise there would be danger of the link swinging too far and so gouging into the shell as the pivot of the link passed into the other quarter of the arc. This is the undesirable feature in the majority of link-controlled profile-turning fixtures, and it was to overcome this difficulty that the fixture here described was designed. The nose of the shell to be turned is shown by the dotted lines, while the tool, mounted on the compound slide, is shown in the position it would occupy after finishing the profile.

The fixture consists of the link *A* which pivots on two studs *B* and *C*, one at each end and spaced a distance apart equal to the radius of the profile to be turned. One of these studs is attached to the cross-slide of the lathe by means of a bridge that is screwed and doweled to the slide, while the other stud is attached to the slide *D* of the attachment. This slide is a close



ATTACHMENT FOR TURNING SHELL PROFILE

sliding fit in the bracket *E*, which is attached to the back of the lathe carriage and travels with it. In order to operate the cross-slide of the lathe with this fixture it is necessary to remove the regular cross-feed screw and adjust the tool to the work by means of the compound-rest screw.

In operation the action is as follows: From the beginning of the cut until the curved portion of the profile is finished the slide *D* remains stationary and

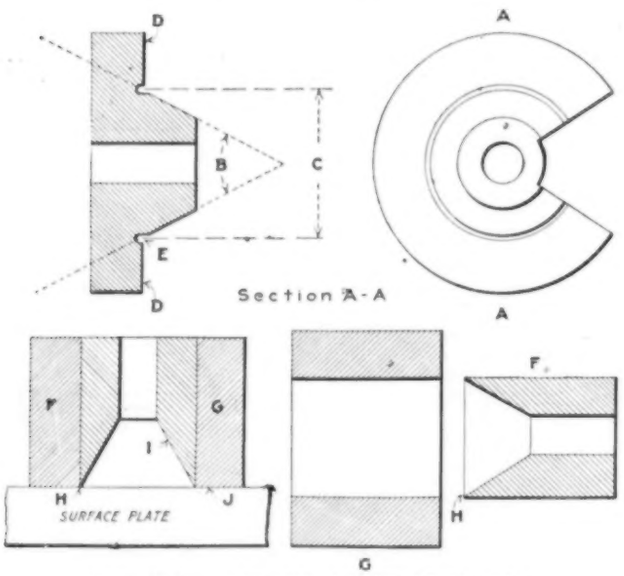
the link swinging on the studs causes the point of the tool to generate a curve the radius of which is the length of the link. Slide *D* is held stationary by means of the stop bar *F*, which is attached to a bracket *G* that can be clamped at any place on the length of the shears. As the tool is fed forward, turning the curved profile, the slide *D* is prevented from moving by the stop bar, which bears against the circular edge of the stop plate *H*. At the moment the curve is finished a projecting corner *I* of the stop plate strikes against the projecting end of the stop bar and prevents the link from turning farther. At the same time this contact occurs the stop bar has come into alignment with a slot *J*, which passes entirely through the stop plate, and as the carriage continues to move forward the stop bar is free to pass through this slot, the link being held against further movement, and so the tool will follow a path parallel to the center line of the lathe. After completing a cut the carriage is returned to starting position, all parts moving together as one unit until the back stop pin *K* brings up against the cap *L*.

At this point the stop bar has withdrawn from the slot in the stop plate, unlocking the latter, and at the same time stopping further movement of the slide *D*. Consequently further movement of the lathe carriage swings the link around its center stud *C* and returns the tool to its original position.

Making Some Difficult Duplicate Gages

By E. A. Dixie

The illustration shows a gage which was ordered in quantities. What makes the job difficult is that there is nothing more tangible than air to hook one's calipers on when ascertaining the dimension *C*. This dimension *C* is a circle the diameter of which is to be measured



THE WORK AND MEANS OF CHECKING

at the imaginary circular line in the groove *E* where the projection of the surface of the cone *B* cuts the projection of the plane *D*. The difficulty is augmented by this diameter having to be kept within a tolerance of plus or minus 0.0001 inch.

I have forgotten the exact dimensions of the original, but no dimensions are necessary to show the method whereby duplicate gages were made which passed the very rigid tests of the Government inspectors.

One idea was to make them in the usual way, measuring them as accurately as possible and trust to luck that the Government inspector could do no better. This however was abandoned for a more positive method which gave accurate results and expedited production.

From the measurements stated on the original blueprint the diameter *C* was readily calculated.

A piece of steel was roughed out, hardened and chucked in the grinding machine. This piece is shown in section at *F*. The outside and angular mouth was accurately ground to dimensions at the same setting. A second piece of steel in the shape of a ring *G* was then accurately ground in the bore and on one face at the same setting. The ring *G* was just warmed and placed face end down on a true surface plate, the plug *F*, which was made a tight push fit for the ring, was then pushed in it till the edge *H* came to a stop on the surface plate. When both pieces assumed the same temperature the plug *F* was a very light shrink fit in the ring *G*. With this master gage and a little prussian blue the toolmaker could with care produce any number of duplicates. The gaging surfaces *I* and *J* were covered with a thin film of prussian blue and used to check up progress of the gages in the grinding machine.

The gages were mounted on a mandrel through the central hole and the cone and flat surface finished at the same setting.

155-Mm. Howitzer Production

This diagram below relates to howitzer manufacture and shows how the American Brake Shoe and Foundry Co., Erie, Penn., had advanced in the production of the

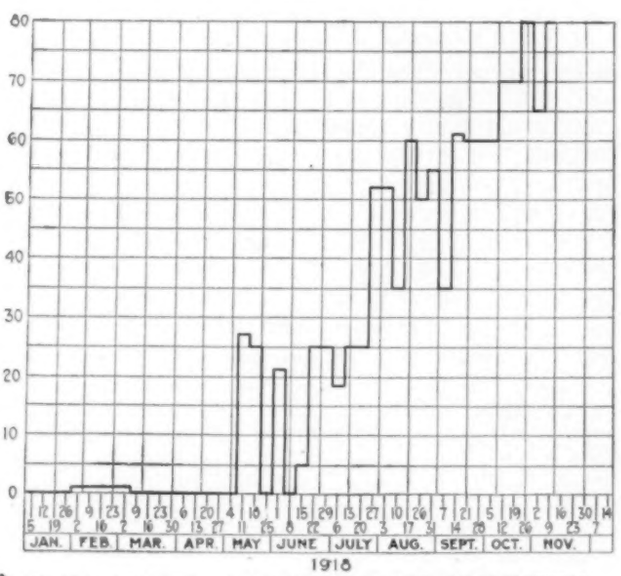
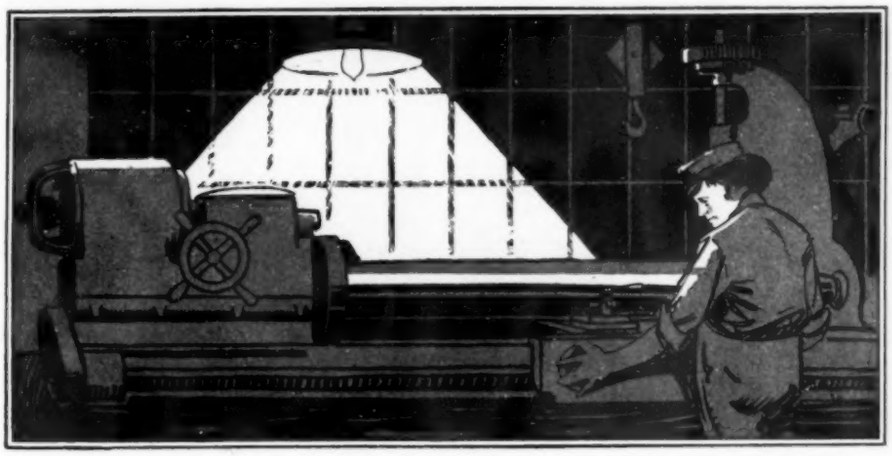


CHART SHOWING 155-MM. HOWITZER PRODUCTION

155-mm. howitzers up to the time of the signing of the armistice. The setbacks were in many cases due to lack of forgings or causes not the fault of the concern. However, in spite of everything, its splendid organization enabled the company to reach and pass its agreed output of 10 a day when running to full capacity.



LIGHT, ELECTRICITY and The Shop

By C. E. Clewell

Motors for Drilling and Boring Machines

This article explains some important points in the use of electric motors for drilling and boring machines. Simple formulas are used to illustrate methods for calculating speeds of drills in terms of other factors, together with a common formula for determining the cubic inches of metal removed per minute. Empirical constants are given for calculating the horsepower required to remove metal based on the latter formula. Tables are included of the motor horsepower recommended for drilling and boring machines of various sizes. Illustrations of motor-driven drilling and boring machines are included and are referred to in detail in the text.

THE many practical advantages of the electric motor and its flexible methods of control for machine-tool driving are quite generally recognized. These advantages, however, are sometimes looked upon merely as general points of convenience without much regard for economy, which must usually be the determining factor when a decision is to be made of the kind of drive to employ for given machinery.

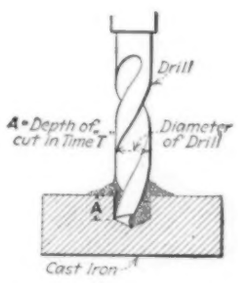


FIG. 1. DIAGRAM OF A TWIST DRILL

In order to bring out the points connected with economy of the motor as a method of driving machinery, there is perhaps no better way than to take up some typical machine or group of machines and make a brief study of the elements which enter in the use of a motor for the given equipment. In this article drilling and boring machines will be considered from the viewpoint of the shopman, and certain fundamentals concerned with the motor and the control mechanism as a part of these machines will be pointed out.

Attention has been directed in previous issues of the *American Machinist* to the importance of looking at motor drive as an aid to greater and better production rather than merely as a means for saving power. At one time there was a natural tendency to use the saving in power by the motor in place of a lineshaft drive as one of the principal talking points of motor salesmen. It is not our purpose to underrate the importance of reduced power losses and a lower power consumption for a given shop output, since this point deserves the most careful attention of shop owners and managers under present national conditions.

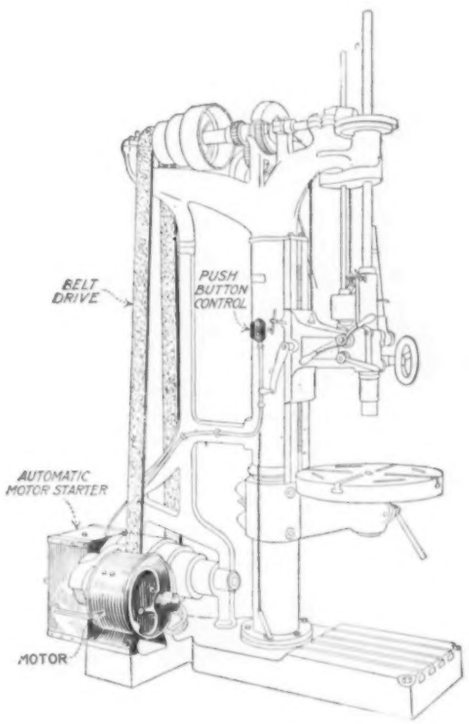


FIG. 2. A DRILLING MACHINE WITH AN AUTOMATIC MOTOR STARTER OPERATED BY A PUSH BUTTON

Possible power saving by the use of motors is only one point to consider, and it is usually of less consequence to the shop management than the question of how the motor may affect the rate of production. On this account it is the purpose to emphasize the latter rather than the former. It should also be observed that even if the adoption of a system of motor driving should result in an actual increase of power consumed, the

system might prove beneficial if a better and a larger product resulted through the use of the motors instead of a purely mechanical system of power transmission.

The above point was presented in an instructive way in these columns by H. F. Stratton based on a

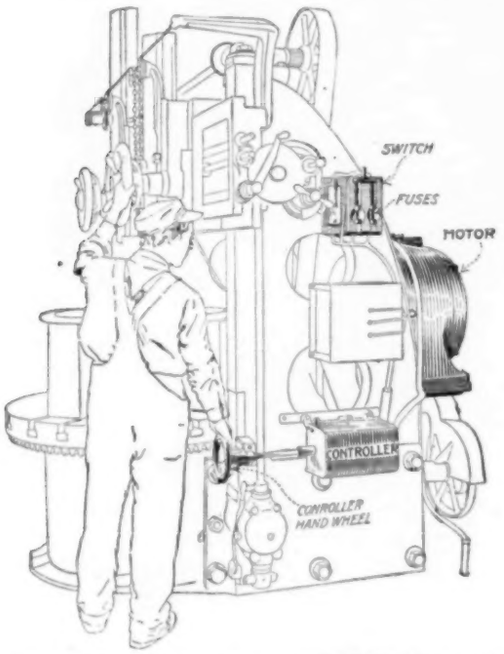


FIG. 3. BORING MILL WITH CONTROLLER AND HANDLE NEAR OPERATOR'S WORKING POSITION

technical paper of A. L. DeLeeuw and may be summarized as follows to illustrate what has just been stated. A shop was cited in which the amount of metal passing through the plant per day averaged 9 tons, this metal being used as the basis of a finished machinery product. It was assumed that all of the power used in the shop was for the removal of metal by machine tools from this 9 tons of material. In the given case a little more than 1 ton of metal was removed per day of 9 hours, which is equivalent to about 300 lb. per hour or 5 lb. per minute.

The power used in this shop amounted to about 225 hp. and this may readily be reduced to the equivalent of 45 hp.-min. for each pound of metal cut or removed, or roughly, about 0.8 lb. of metal was removed per horsepower-hour. The shop was electrically driven, with a cost for power of about $40 per horsepower-year, or a gross annual power cost of 225 × $40 = $9000.

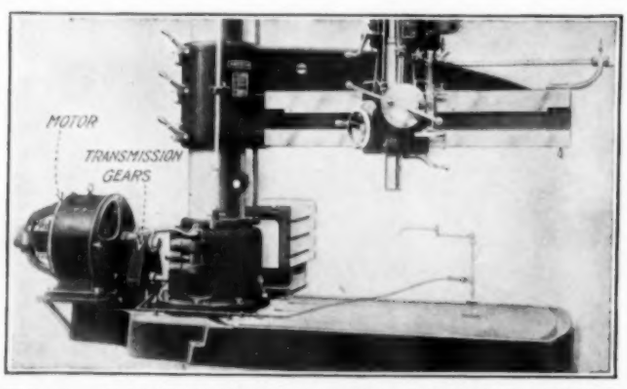


FIG. 4. ADJUSTABLE-SPEED MOTOR DIRECTLY GEARED TO RADIAL DRILLING MACHINE

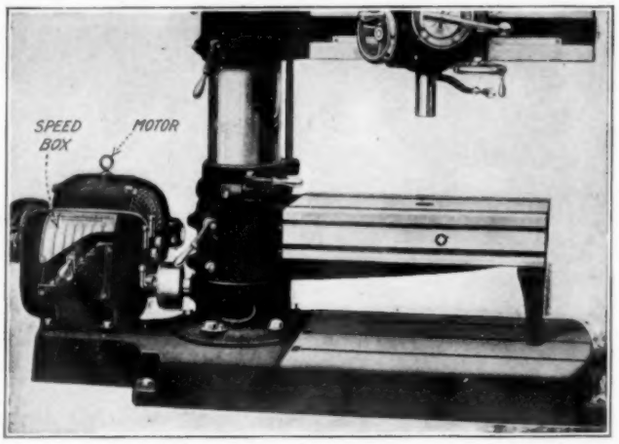


FIG. 5. INDIVIDUAL MOTOR ATTACHED TO A RADIAL DRILLING MACHINE THROUGH A SPEED BOX

The main point of the argument is in the comparison of a given power saving with a given increase in production. Suppose a new method of drive could effect a saving of 50 per cent. in the power consumed by the shop; one-half of $9000 would be $4500.

The shop employs about 500 men and the value of the plant output is about $2000 per man per year. If a new method of driving the machinery made it possible to increase the production 1 per cent. this would be equivalent to $20 per man per year increase, or a total of 500 × $20 = $10,000 for the entire shop. This is more than double a saving of 50 per cent. in power. Hence, it may readily be seen that a 1-per-cent. increase in production (or a saving of about 6 min. per man per eight-hour day in the time required to get out a given amount of work) may be of greater importance than even a 50-per-cent. power saving. The practical significance of this principle will be made clearer further along in this article.

Simple Formula for Drills

In the application of motors to machine tools it may be advisable to know something of the simple methods for determining speeds, feeds and horsepower. The twist drill shown in Fig. 1 may be used as a basis for some of these relations. Suppose, for example, the desired cutting speed in feet per minute and the diameter of a drill in inches are known and the revolutions per minute of the drill is to be found. Reduce the cutting speed from feet per minute to inches per minute and divide by the circumference of the drill in inches; that is,

$$\frac{\textit{Cutting speed in feet per minute} \times 12}{\textit{Diameter of drill in inches} \times 3.1416} = \textit{revolution per minute of drill.}$$

This same relation may be used to calculate the cutting speed of the drill in feet per minute when the diameter of the drill and the revolutions per minute of the drill are known, in which case the formula takes the following form:

$$\frac{(\textit{Diameter of drill in inches} \times \textit{revolutions per minute of drill} \times 3.1416)}{12} = \textit{cutting speed in feet per minute.}$$

Tables are available and may be consulted for finding the feeds in inches per revolution of the drill (or in

FIG. 6. LARGE TWO-MOTOR HORIZONTAL MULTIPLE-SPINDLE DRILLING MACHINE

other terms) for a given class of metal worked upon, and for given drill diameters and revolutions per minute corresponding to a given cutting speed.

Convenient tables have been prepared for the aid of those who must decide on the horsepower rating of a motor to use for a given size and kind of machine tool. Several tables of this kind are given below, for which it is understood in each case that either of the three general types of shop motors on the market may be used; that is, the adjustable-speed direct-current motor, the constant-speed direct-current motor, or the induction motor, which is a constant-speed machine. The exact choice of which of these types of motors to use depends on other and important considerations besides the mere choice of rating of the motor as given in Tables I, II and III.

TABLE I.—RECOMMENDED HORSEPOWER RATINGS FOR MOTORS FOR DRIVE DRILLING AND BORING MACHINES

Size	Hp.
Sensitive drilling machines up to ½ in.	¼ to ½
Upright drilling machines, 12 to 20 in.	1
Upright drilling machines, 24 to 28 in.	2
Upright drilling machines, 30 to 32 in.	3
Upright drilling machines, 36 to 40 in.	5
Upright drilling machines, 50 to 60 in.	5 to 7½

	Horsepower — Heavy	Average
Radial drilling machines, 3-ft. arm	3	1 to 2
Radial drilling machines, 4-ft. arm	5 to 7½	2 to 3
Radial drilling machines, 5 to 6 and 7-ft. arm	5 to 7½	3 to 5
Radial drilling machines, 8 to 9 and 10-ft. arm	7½ to 10	5 to 7½

If it is desired to make a rough calculation of the horsepower required to drill a certain kind of metal this may be done by the use of the following simple relation for the cubic inches of metal removed per minute for drills; that is,

Cubic inches of metal removed per minute $= 0.7854 \times D^2 \times \frac{A}{T}$ where D is the drill diameter in inches, and $\frac{A}{T}$ is the feed of the drill in inches per minute (see Fig. 1). Based on the result of the cubic inches of metal removed per minute as just found the horsepower required for removing the metal may be found from the table of constants:

Metal Drilled	Approximate Horsepower per Cubic Foot of Metal Removed per Minute
Cast iron	0.6 to 1.0
Wrought iron	1.2
Machinery steel	1.2
Steel 0.50 per cent. carbon and harder	2.0 to 2.5
Brass and similar alloys	0.4 to 0.5

Note—Where the cut is very light the friction of the machine tool may alone be the determining factor in the size of motor to use. However, if the cut is heavy, friction may sometimes be ignored as an item of negligible importance.

Turning to the details in the application of motors to drills and boring machines it will be possible to explain some of the ways in which the economies of the motor show themselves in actual practice, and it should be remembered that the saving of time in finishing a given piece of work need not necessarily be large to make the use of a motor a paying investment.

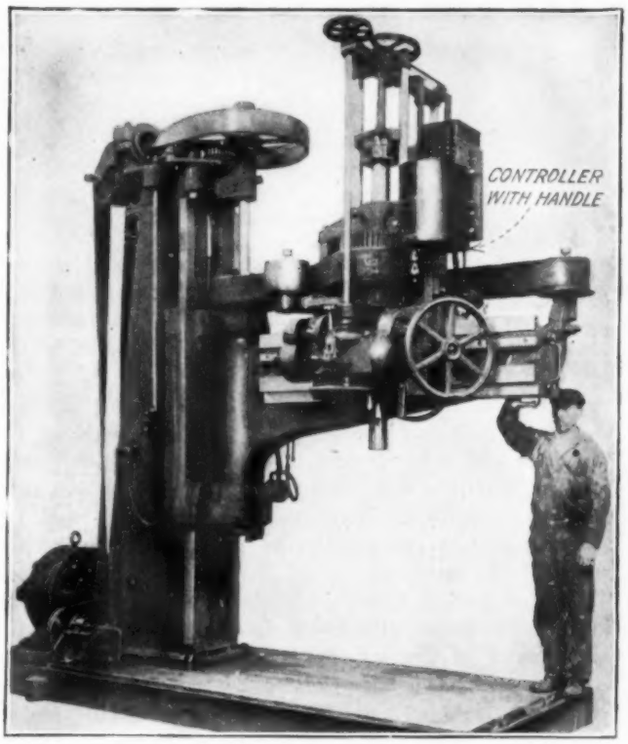


FIG. 8. RADIAL DRILLING MACHINE WITH CONTROLLER WITHIN EASY REACH OF OPERATOR

First, the use of the electric motor brings with it the possibility of many points of excellence in the way in which the machine tool is started and stopped and its speed adjusted or varied. This, in fact, is one of the great advantages possessed by electric-power applications. Fig. 2 illustrates the automatic starter with push-button control, which gives the operator the convenience of starting and stopping the motor by merely

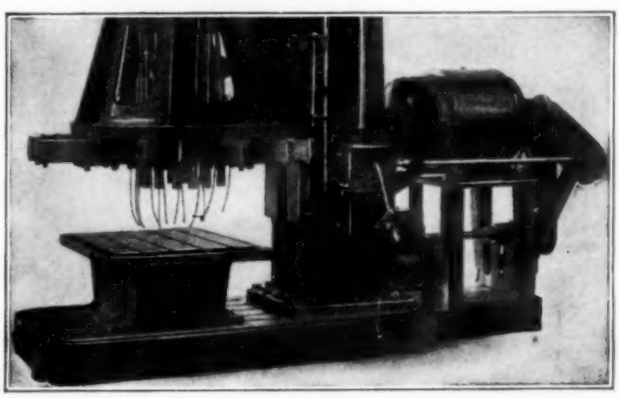


FIG. 7. VERTICAL MOTOR-DRIVEN MULTIPLE-SPINDLE DRILLING MACHINE

TABLE II.—RECOMMENDED HORSEPOWER RATINGS FOR MOTORS TO DRIVE BORING AND TURNING MILLS

Size	Horsepower — Average	Heavy
37 to 42 in.	5 to 7½	7½ to 10
50 in.	7½	7½ to 10
60 to 84 in.	7½ to 10	10 to 15
7 to 9 ft.	10 to 15	
10 to 12 ft.	10 to 15	30 to 40
14 to 16 ft.	15 to 20	
16 to 25 ft.	20 to 25	

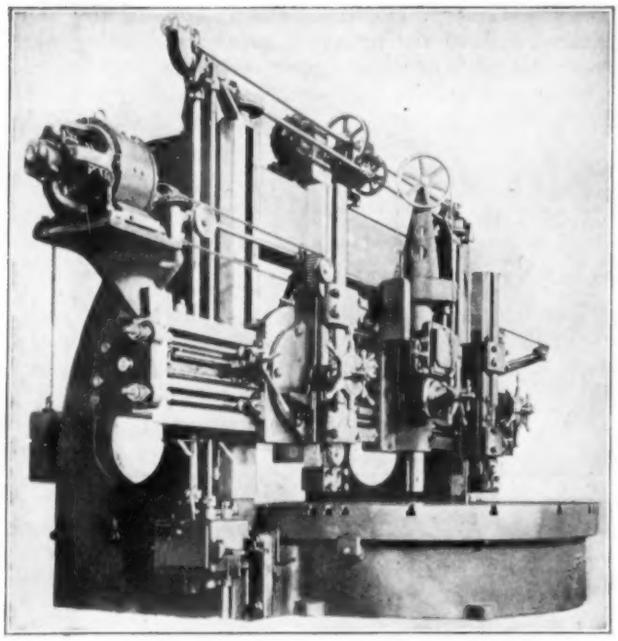


FIG. 9. SURFACE-GRINDING MACHINE WITH VERTICAL DRIVING MOTOR

pressing the push button. This is only one of the advantages of the motor. The drilling machine in Fig. 2 has its speed controlled and adjusted by the ordinary cone pulleys and belt, and no effort is made to use speed control by electric means.

In Fig. 3, however, a motor-driven boring machine is shown with a controller located on the side of the machine, and a handwheel is so placed that the operator has it within convenient reach when in his normal operating position. The controller may be used for starting and stopping only, or for the control of the speed of the machine.

Figs. 2 and 3 have contrasted motor-driven belted drilling machines with those direct connected, and the advantages of the latter have been emphasized from the point of economy through control. Another contrast may now be made of two direct-connected motor-driven drilling machines, in one of which speed changes may be made by the motor controller (Fig. 4), and in the other the speed changes are secured through a speed box (Fig. 5).

TABLE III.—RECOMMENDED HORSEPOWER RATINGS FOR MOTORS TO DRIVE CYLINDER-BORING MACHINE

Diameter of Spindle, In.	Maximum Boring Diameter, In.	Hp.
4	20	7½
6	30	10
8	40	15

A number of points must be given due weight in making a comparison between Figs. 4 and 5. First, the speed control through the motor is usually preferable, due to its convenience and its greater flexibility. To accomplish this the motor must possess the necessary characteristics for adjusting its speed over wider limits than can be obtained with the ordinary direct-current shunt motor. Direct-current motors with these wider limits of speed adjustment are known as adjustable-speed motors and they cost and weigh more per horsepower than the ordinary direct-current shunt motors, so that the cost of the motor itself is increased by this advantage of wide speed control, making the initial investment charge higher than where, as in Fig. 5, speed adjustments are secured through a speed box and a motor of constant-speed type.

The advantages of the motor often rest largely in its ability to secure wide speed limits with close graduations of speed, and this advantage may easily offset whatever difference in first cost there may be between the two cases illustrated in Figs. 4 and 5. These two examples are given to bring out one of the fundamental points in the adoption of a system of motor drive, and the reader can see that the problem is one which should be solved on a basis of careful preliminary estimates as to what the adjustable-speed motor equipment is going to be worth to the shop in comparison with the less costly types of motor outfits, and on a basis of actual experiences in other shops where data are available on the points at issue.

Motors on Large Multiple-Spindle Drilling Machines

To bring out the importance of this question in its relation to large drilling machinery, Figs. 6 and 7 are shown. The two views refer to a large two-motor horizontal multiple-spindle drilling machine and to a vertical machine of the same type.

The reader will find it of interest to note both in Fig. 6 and Fig. 7 how the adaptation of the motor to the machine tool has been made mechanically. This point is an important one and the success of the combination depends partly upon the design of the machine tool itself, and partly upon the coöperation of the motor manufacturers in designing their motors and control equipment to meet given special requirements.

This is illustrated, from the standpoint of control equipment, in the placing of the motor controller in a

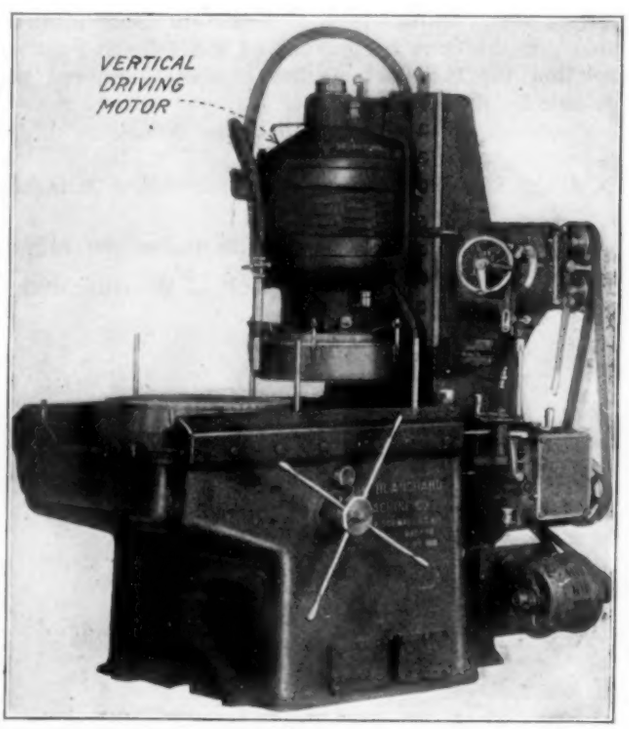


FIG. 10. STANDARD BORING MILL WITH MOTOR DRIVE

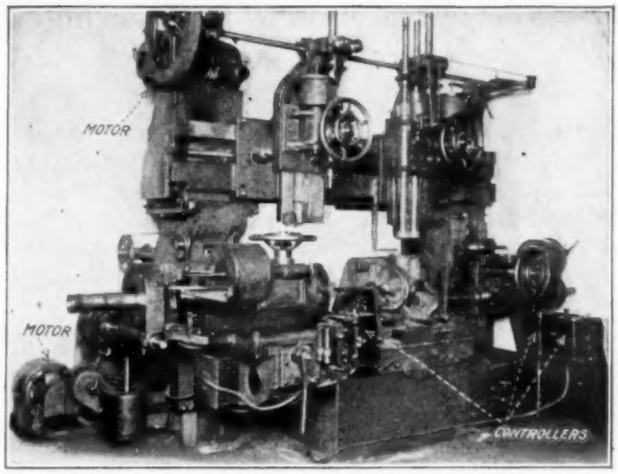


FIG. 11. MOTOR DRIVEN FIVE-SPINDLE BORING MACHINE

convenient position near the operator as clearly indicated in Fig. 8. From the standpoint of the motor, Fig. 9 shows very nicely how the type of motor may be suited to special uses. This machine is equipped with a vertical 7½-hp., 440-volt motor, and its compact appearance as well as that of the motor as a unit is in itself an indication of the care which has been taken to adapt the motor to the machine in the best manner.

The preceding notes are equally applicable to the boring machine, except perhaps in those few cases where specific information was given for drilling machines. In closing this discussion it is desirable to refer briefly to several examples of boring machines as one of the many fields for the motor-application engineer.

For this purpose Figs. 10 and 11 are included to illustrate some of the points in the successful application of the motor to such machinery. Fig. 10 shows a large boring machine with the driving motor at the upper left portion of the view, and an auxiliary motor at the top center of the machine. This view may be taken as a good example of a motor-equipped standard type of boring machine, while Fig. 11 is intended to bring out the motor and control equipment for a special type of boring mill, this particular one being a five-spindle mill. In the latter case three motors are employed, two of which are shown in the view, and the three corresponding controllers are properly indicated by arrows.

These notes, although related mainly to two types of machine tools, are intended to emphasize more than a description of the electrical equipment of two standard machine tools, and therefore place a good deal of weight on the important principles of motor-application work, using the drill and the boring machines merely as a convenient basis for the discussion.

A Scientific Santa Claus

BY JOHN R. GODFREY

"'Twas the day after Xmas,
And all through the shop
The workers were cussing
The men at the top."

THIS was the nice Christmas spirit Johnson found waiting for him when he landed in the shop on the morning of Dec. 26. Now Johnson is a good sort of a scout even if he did fall for the Foolem and Gouger bunch, and Christmas meant a lot to him. Gave him a chance to go around and say "howdy" to the men, to ask after the kiddies and to be real human, as was his nature. But he sure did get a jolt when he stuck his nose into the shop on Dec. 26.

He didn't have to be told that something was wrong; he could feel it, and he called in one of his old-time foremen to ask him what it was all about. Dooley was a bit reticent at first, but Johnson pried a few answers out of him.

"Now, see here, Bill Dooley, what's the matter out in the shop? I've been away and I don't know what to think. But something has surely happened to sour the disposition of every man I've looked at. Tell me the worst, Bill; I want to know—and I want to know now."

So Bill Dooley loosened up in his own way and told Johnson just how a scientifically managed Christmas was pulled off.

"You see, Mr. Johnson, 'twas this way: Young Gouger comes around and wants a list of every man in my department. Wanted to know his age, habits and condition of matrimonial servitude. Leastwise, he wanted to know if he smoked, had a family and other personal information. Then he wanted to know whether each man would rather have a turkey, cigars or three bucks in coin of the realm.

"That wouldn't have been so bad, but he got his lists mixed and had turkeys assigned to the men who wanted smokes and cash. That made things interesting and got the boys a bit peeved.

"In the old days when they brought the plunder into the department, or at least had the turkey all ready to pick up as they went home, there was a kind of a Christmasy feeling about it. Each foreman sort of played Santa Claus to his own department and passed the personal touch down the line. Everybody knew you couldn't 'Merry Xmas' the whole gang, and they sorter felt as though we foremen acted in your place.

"This year it was different. After they got the pedigree of every pup in the kennel they gave him a number and told him to freeze tight to it—same as he would a hat check at a policemen's ball. Then they posted diagrams which showed distributing points for the various kinds of gifts.

"The three-dollar men had to go out on the street and line up past the window of the cashier's office; the smokers lined up alongside the pattern shop, and the turkeys were given out by the main gate.

"Perhaps you remember what a nice night it was on the 24th—a nice cold, cheerful rain that almost froze as it struck the sidewalk. Made a man feel real cheerful and merry to line up to get his three bucks, especially when he'd been counting on a good, fat bonus same as he had last year. Your personal stock dropped way below par that night, Mr. Johnson, because most of us thought you must know all about it.

"Perhaps you can't just see the effect of all this cut-and-dried scientific stuff the way we do; but I'll bet seven dollars to a plugged nickel that the production of the plant drops lower than you've seen it for some time. The men used to take a real personal interest in the work; this has knocked that into a cocked hat. Six o'clock and payday will be the bright spots in the life of most of the men from now on. It wasn't the money; it was the idea of being handed a lot of bunk about good-will and Merry Christmas and then being led up to a cold-blooded bread line like a soup kitchen in Belgium. Three of my best men gave notice this morning."

Johnson didn't know whether to be peeved at the fluent criticism or to look at the other side and see the men's state of mind. While he was thinking, the boy brought in two envelopes, one, a large one, evidently containing a picture. This was another evidence of the wrath of the men in the shop. For there was a halftone cut from a local paper showing a banquet given by some of the officers a few nights before and underneath: "Our Officers Eating our Xmas Bonus."

As a matter of fact each officer had paid his share of the eats, but the men didn't know that. And the shot found its mark. In the other envelope was a notice from the Red Cross saying that three dollars had been subscribed in his name by one of his men. Later he found that several had not called for their three dollars at all—the cold, drizzling rain, the possibility of catching cold and the general "darn the scientific Xmas" spirit being clearly shown.

Now, as I said before, Johnson was a real human being when he took time to think about it. And these things hurt him more than he would admit. He valued the good-will of his men and he also knew that what Bill Dooley had said about production was true. You can't buck a grouch of the whole shop when they feel they have a good reason, and he admitted to himself that they had. So he took the bull by the horns and called a meeting of the shop foremen, subforemen and all the old timers he could get into his office. He also sent for Foolem and Gouger. And this is what he said:

"Boys, I've been away and I've just heard about the sort of scientific Xmas that was put over on you while I was gone. Let me tell you right now there'll never be another like it in this shop. Our friends Foolem and Gouger get through tonight, but they didn't know it till now. I've stood for a lot of "damfoolism" because I thought perhaps they had some things we needed. *I'm* doubtful now if they have anything. Anyone who will take every human element out of Xmas as they did can't have much else that we want in our shop.

"Tomorrow I'm going to consult a real manager I've run across and see whether there's any of their junk we can use or not. If there isn't it all goes out into the street. I can't say anything very definite yet about the future, but I ask you to try and forget the nightmare we've had and give us a chance to get the shop back into the human column once more. We'll need your help, every one of you, and the help of every man in the shop. Pass the word along too when you go back. We've got to pull together—and we will—whether we are scientific about it or not."

Who says Johnson isn't a real human being?

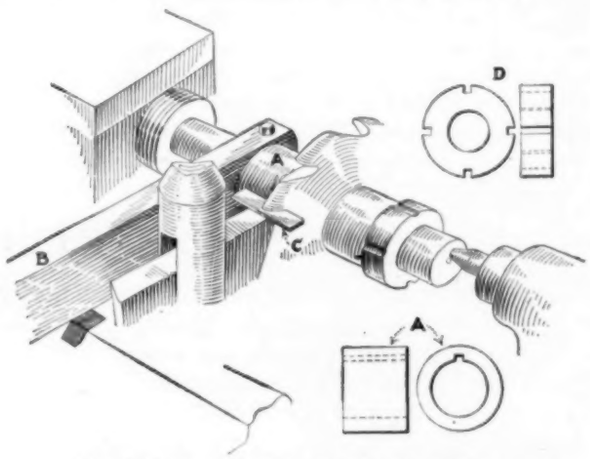
Eccentric Mandrel for Relieving Form Cutters

BY GEORGE F. KUHNE

The sketch shown is an eccentric mandrel for use in relieving the teeth of form cutters. Although machines and attachments are on the market for such work this one is intended for the shop in which such cutters are seldom made and the purchase of a machine would therefore be inadvisable. Little explanation is needed, as the cut shows practically all the detail.

The collar *A* is splined to the mandrel by means of a Woodruff key that is let into the latter, the object being to keep the cutter from shifting its position when the nut is tightened.

The mandrel is operated by the lever *B*, which should be so located that as it descends and the forming tool is cutting it will strike the lathe apron before the next tooth of the cutter strikes the forming tool. In locating the cutter the lever *B* should be brought down onto



MANDREL FOR RELIEVING CUTTERS

the apron after the cutter is on the mandrel, and the tooth above the one to be relieved should be set against a flat piece of metal *C* held on top of the tool.

After setting in this manner the threaded collar *D* is tightened to hold it in position for relieving. A stop should be used on the cross-slide to make sure that the relief is made uniform.

Welding High-Speed Forming Tools

BY J. S. ATKINSON

I was much interested in the article by Harold V. Styers on page 1186, Vol. 49, of the *American Machinist* regarding breakage of dovetail forming tools.

His sketch shows a fracture starting at the sharp corner of the dovetail and running across the entire piece, which is a good example of what often happens to tools of this shape. Sharp corners of this kind could well be obviated by a small fillet, which would tend to prevent hardening cracks at this point. Toolmakers are well aware that a sharp corner of this sort invites breakage. A slight clearance would of course be necessary on the holder so as not to bear in the filleted corner.

I believe this would be a good point for designers to bear in mind rather than to always rely upon the toolmaker to make a fillet.

The Salvage of High-Speed Steel Tools

By J. H. Vincent

The salvage of high-speed steel is drawing attention to obtaining maximum life for every tool or cutter made from it. Many milling cutters have been thrown in the scrap heap when ground until there is insufficient chip space left. These are now being salvaged at comparatively small cost by a method of grinding without drawing the temper of the cutter, which is a big advantage.

WHEN high-speed milling cutters and reamers were worn down to the point where there was little or no chip space left, as shown in the headpiece, it was customary for the toolroom attendants to throw them into the scrap heap, and it was seldom this steel was later used for any purpose. During the past year or two, since the value of high-speed steel has so materially increased, some attention has been given to keeping this high-speed-steel scrap separate and selling it for more than ordinary tool-steel scrap, from 15 to 20c. per pound being obtained from jung dealers. This, however, is litfle better than nothing when it is considered that a cutter such as shown in the photograph may take from 10 to 30 lb. of steel in the blank to produce it.

With high-speed steel selling at about $2 a pound, and hard to get at any price, the material tied up in cutters and reamers of this description is a big item, so when these tools can be salvaged the methods employed should be of interest. The Goddard & Goddard Co., Detroit, Mich., has been salvaging cutters for their customers for some time, the cutters illustrated in the headpiece being reproductions of some of the worn-out tools that were sent in for the purpose. What can be done with them is amply shown in Fig. 1, which gives a group of similar tools that have gone through the shop and been put into shape for returning to their owners. It will be observed in this group that reamers, end mills and high-speed drills are included among the salvaged tools. The drills had been worn so badly that they were undersized and no longer had clearance. On being reground to a smaller size and the necessary clearance ground on them they are as good as new drills.

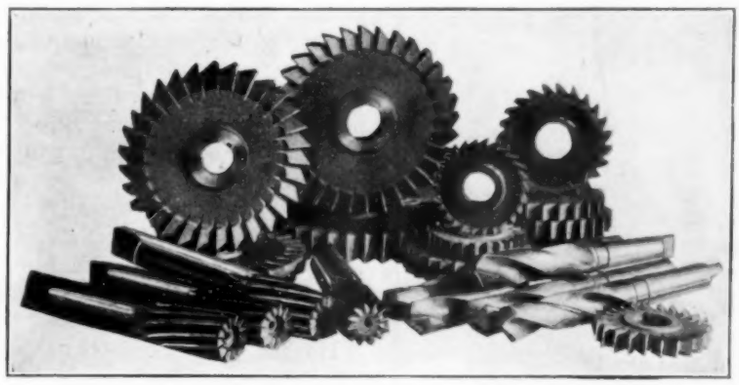


FIG. 1. GROUP OF RECUT TOOLS

FIG. 2. GRINDING CHIP SPACE ON MILLING CUTTER

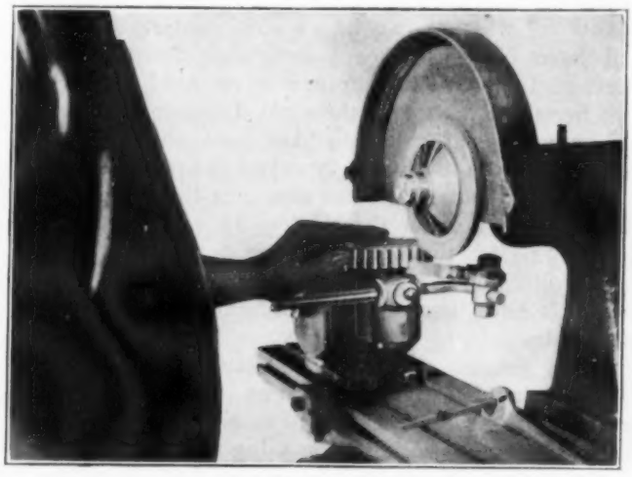


FIG. 3. GRINDING SIDE FACE OF MILLING CUTTER

When a manager receives a report from the foreman of the toolroom that certain milling cutters require regrinding he should have him specify the sizes of the smaller cutters of similar type used in the plant to which these worn cutters may be ground. Any plant using large numbers of cutters has a variety of small sizes and it is usually possible to grind the larger size down to do service. In sending in such cutters for regrinding the customer should mention the size sent in as well as the size to which he wishes it ground. In this way nothing is left to chance.

The development of regrinding is a trade in itself, and has demanded the study of those who are expert in the work in order to obtain the best results. The practice of Goddard & Goddard is to regrind all tools without drawing their temper. This requires the employment of exceptionally well-trained grinders. The work is done dry, Figs. 2 and 3 showing the method of grinding the chip space on the outside periphery and flat side of a milling cutter.

FIG. 4. ACID STENCILING SIZES ON SALVAGED TOOLS

The company also makes new milling cutters that are designed to give longer life and better opportunities for regrinding or salvage. For this reason the web is left thicker on the new cutter instead of unnecessarily thinning it when they are first made. End mills have their centers bored out to a considerable depth, so that when grinding new chip space the grinding wheel will not run into a solid center.

I have frequently heard complaints from toolroom foremen in regard to reground or salvaged cutters being permitted to retain their old dimension markings, in consequence of which mistakes were constantly being made when the tools were issued to the workmen. The Goddard & Goddard Co. has overcome this by grinding off wherever possible the old tool dimensions or markings, and after the work has been finished the cutters are sandblasted so that they look new in every way. As the tools have been hardened ordinary stencil marking cannot be used to indicate the new sizes, but an acid-marking process provides an effective substitute.

The woman in Fig. 4 is engaged at stenciling. After each tool has been checked and rechecked by inspectors the correct tool size is put on a tag which accompanies the piece, and then goes to the stenciling department. A light coat of varnish is applied to the space to be stenciled, and the lettering is stamped on this with a rubber stamp wet with a potash solution which eats through the varnish, leaving an acid-proof background. A little acid is then applied to the letters and allowed to stand for a few minutes. When washed off the letters have been etched on the tool and the varnished background is cleaned with alcohol.

The cost of salvage is remarkably low in comparison with the cost of new tools at the present time, and everyone should be urged to make a regular inspection of his tool-scrap bin to see whether anything is being scrapped which could be salvaged.

Don't Jump at Conclusions

BY H. K. PORTER

Some men are inclined to feel that somebody or everybody has a grudge against them and that plots intended to bring about their downfall are being hatched whenever their backs are turned or whenever they are away from the shop or plant for a day or for a few days.

A factory or plant manager must not, however, possess such a nature if he expects to make a complete success of his work or management, for suspiciousness may be reasonably interpreted as ignorance. No man should believe that his "friends" or employees are plotting his ruin, for if he does his actions will lower his efficiency and undermine the respect of his superiors and subordinates.

I once knew such a man who narrowly escaped such a fate because of his belief that his men were working against rather than with him. The only thing that saved him was the fact that he was the head of the shop and no one had the authority to "fire" him.

He had just taken charge of a shop which though ideally situated had been run in a loose manner for years, with expenses equaling and often exceeding the profits, and right away he started in to "shake up" the force so as to get the plant on a money-making basis. He wanted a real organization. As a consequence he made some enemies among the employees who prior to the time he took charge had worked as they saw fit. Let me add, however, that it is but natural for every successful man to have some genuine enemies. A progressive man brushes aside the laggards and they usually resent it.

For this particular executive things were going ahead at a fair clip when suddenly the air compressor of the plant broke down, shutting down the plant. Immediately the superintendent convinced himself without the formality of an investigation that the men whom he had forced to toe the mark had thrown sand in the bearings. He raved in a manner entirely unbecoming an able leader. Two or three men were virtually kicked out, and the whole force was upset.

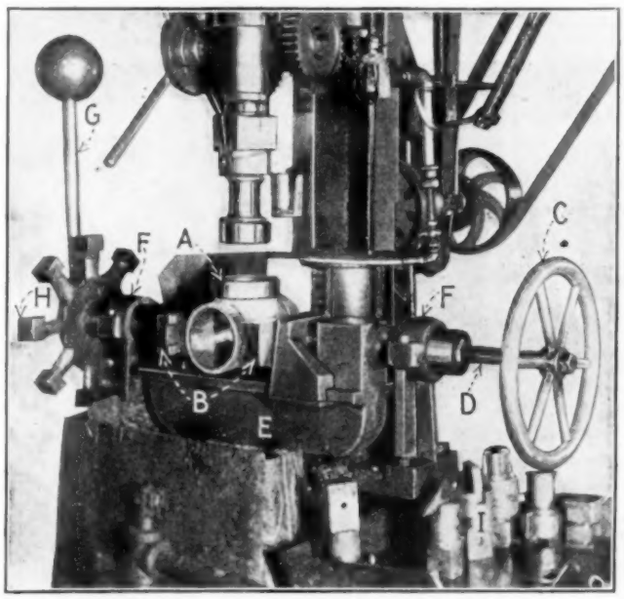
An expert was put to work on the job to get the plant in operation again as soon as possible, and instead of finding sand in the bearings the expert found that improper lubricant was the cause of the trouble. A lubricant "expert" had slipped a cog and recommended the wrong kind of oil.

After the smoke had cleared away, the superintendent came down to earth again and is now reformed.

Tapping Fixture for Pipe Fittings

By H. J. Ventner

The fixture shown in the illustration is employed in the plant of the Jarecki Manufacturing Co., Erie, Penn., for drilling and tapping small lots of large pipe fittings. This fixture is used in a standard drilling machine and enables the operator to drill and tap all sides of these fittings at one setting, thus insuring the correct alignment of the various threaded holes.



TAPPING FIXTURE FOR PIPE FITTINGS

The tee *A*, which in this case was made of aluminum, is held in the vise jaws *B*, which are closed by the handwheel *C* and screw *D*.

The main body of the fixture *E*, carrying the vise jaws, has trunnions on each end that rest in bearings on the bracket *F*, thus permitting the central portion to be freely revolved.

The revolving body is counterweighted by the bar *G*, with the ball on its outer end. The indexing is accomplished by the spider *H*, which has indexing points at 45-deg. intervals, thus making this fixture available for fittings other than 90 degrees.

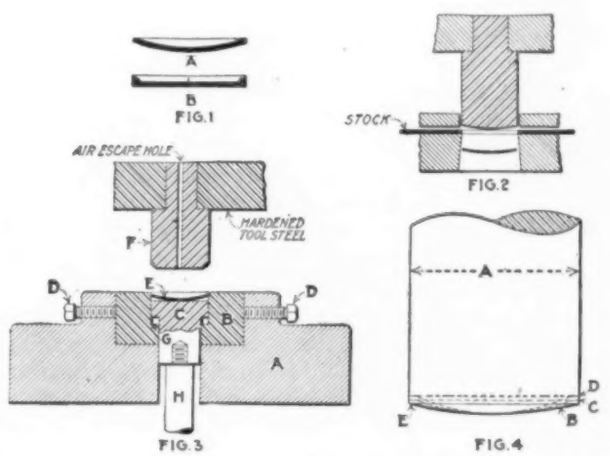
Tools used for clearing the fins and burs from the holes and preparing the casting for the tapping operations are shown on the tray *I* at the right of the machine. The machine is geared to a slow speed and is readily reversed to withdraw the tap.

Trying to Thicken the Edges of a Disk

By Hugo F. Pusep

In an article by Joseph A. Ahlers on page 707, Vol. 49, a description is given of an unsuccessful method of thickening the edges of a disk. For the benefit of Mr. Ahlers and others confronted with similar problems I submit sketches of tools which will produce the disk in question. The disk *B* of the original article can be produced in two press operations, namely, blanking and swaging.

As an illustration of what can be done by this method the sketch *B* in Fig. 1 represents the cross-section of a brass disk, which was produced very successfully in two operations. Fig. 2 shows the first-operation tools for blanking and drawing the shallow cup *A* in Fig. 1. These consist of a simple blanking die and a punch, the face of which is ground convex. The stripper should be a little higher from the face of the die than is usually the case on ordinary blanking dies to allow free passage of the stock, which is subject to slight distortion around the punched hole caused by the convexity of the punch.



FIGS. 1, 2, 3, 4. BLANK, TOOLS, AND BLANKING PUNCH

The final operation is swaging the blank into the thickened edge disk shown at *B*, Fig. 1. Swaging dies for this operation are illustrated in Fig. 3. The cast-iron die shoe *A* is bored out to take the hardened and ground tool-steel die ring *B*, the larger hole in which is ground to the diameter of the finished blank, while the smaller hole is made a sliding fit for the stem of the hardened and ground knockout *C*. The head of the knockout is accurately fitted to the larger hole in the die. Although the die ring is a press fit in the shoe

additional precaution in the form of setscrews *D* is taken to guard against its loosening through continued jar of the knockout.

In operation the swaging die works as follows: The shallow cupped blank *E* is placed in the die as shown, resting on the knockout and being centered by the die opening. As the punch *F* descends it carries the blank down along with the knockout *C* till the latter is stopped by the shoulder *G* of the ring. Further downward movement of the punch flattens the center of the disk and swages the edges down into the corner of the die against the face of the knockout, while the top side of the disk is shaped to the form of the punch. On the up stroke of the press the finished disk is ejected by the positive movement of the knockout *C* actuated by the rod *H*. The knockout *C* is so set that it will come flush with the top of the die ring on ejecting the swaged blank, returning to the position shown in the sketch, just as the press ram comes to rest at its highest position in order that the blank, which is swaged tightly into the die, may be completely ejected and still allow a new blank to be centered properly by the die.

The success of the process of thickening the edges of disks of brass or like material depends largely on the form of the first blank. Mr. Ahlers did not state the material his blank was made of, but I assume it to have been either brass or other composition of like nature, on account of the press methods he tried in its production. Steel does not swage to form like this when worked cold, and if a disk had to be produced as specified in Mr. Ahlers' article either the drop hammer or the upsetting machine could have been used successfully for the purpose.

All swaging dies of the kind described should be made massive in proportion to withstand the stress of swaging. Punches and dies alike must be highly polished on their working surfaces. The punch and the knockout should be a perfect fit in the die to prevent the metal from squeezing past them and forming objectionable burs. All blanks should be annealed before swaging and must be free from oil and other foreign matter. Sometimes air holes must be provided in the punch or the knockout, or both, depending on the form of the thickened rim to be swaged.

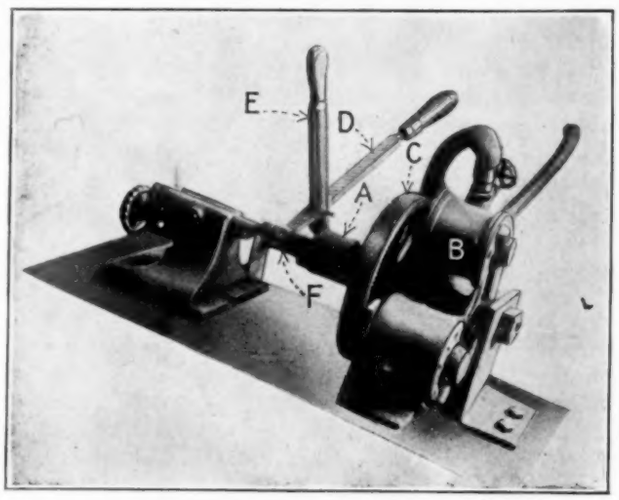
It is always advisable in swaging to provide a press with ample power; rather use one with power to spare than one that barely does the work. Another important point, the overlooking of which sometimes causes trouble and even rejection of the method, is that the punch must be shouldered into a hardened tool-steel punch holder of sufficient thickness and size to prevent the punch from sinking into it as it would if it were made of cast iron or soft steel.

The correct form of the blank for swaging can best be determined by trial. The best and cheapest way to do this is to build the blanking die complete, because the diameter of the blank will not change, being governed by the diameter of the swaging die. The blanking punch is now made and ground after hardening to the right diameter as at *A*, Fig. 4. The face of the punch is ground by guess to the form as shown at *B*. A trial blank is produced with this punch, and if it is found there is not sufficient stock in this blank to fill out the swaged disk, the face of the punch is ground as represented by line *C*. After further trial it may be necessary to increase the convexity of the punch face to line *D* or until the desired result in the swaged blank has been attained. From this it will be seen that all the alteration takes place in the face of the blanking punch and is accomplished simply by grinding. The square corner at *E* should be always left in a combination cupping and blanking punch; it assists materially in the blanking operation, as it overcomes some of the distortion in the strip stock and also leaves a clean, smooth hole. Although the blank, for the swaging of which the tools described in this article were designed, differs somewhat from that of Mr. Ahlers' original articles, it is, if any, the more difficult of the two to make.

A Pneumatic Thread Chaser

BY E. V. ALLEN

Bruised or oversized threads on a bolt or screw are usually rectified by running a die over them. In some cases a slightly bruised thread may be touched up with a file. The method used in the Northwestern R.R. shops, Chicago, is to chase down both oversized and bruised threads in the little machine shown. In this case the bolts are those used in piston heads and are centered for the threaded end.



A PNEUMATIC THREAD CHASER

The machine is made somewhat similar to a small lathe, with an adjustable tailstock center and a headstock carrying a spindle with a socket *A* on the nose into which the head of the bolt is placed. The spindle is driven by means of an air motor *B* the pinion of which meshes with the internal gear *C*. The thread chaser *D* is carried in a lever-bracket *E*, which is made to slide freely back and forth in a guide bar *F*.

As the bolt turns, driven by the air motor, the workman presses the chaser teeth into the thread and allows the chaser to feed along, cutting down the oversized thread or cleaning out the bruised places, as the case may be.

One big advantage of this little machine is that it can be carried anywhere in the shop and used, as there are few places in a railroad repair shop where compressed-air connections are not available.

The scheme is also much quicker than the use of a die.

Punching and Coping Metal Sills For Railway Cars

By C. M. Rogers

The box car shown in Fig. 1 is one of several hundred being built by our company for the expeditionary forces in France, which must interchange with French cars. There is a hook and link attachment at each end of the car, with two safety chains, for coupling one car

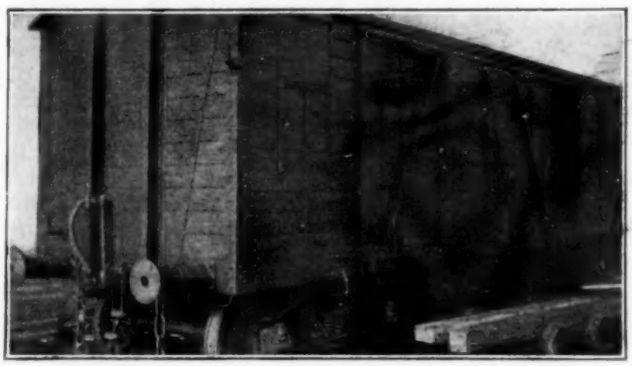


FIG. 1. CARS USED BY EXPEDITIONARY FORCE

to the next, and a buffer near each end of the end sills, with a heavy spring back of it to take the buffing shock.

Since a large part of this shock is transmitted to the side sills it is necessary to have the end of side sills a snug fit into the end sills. The construction of the corner of the steel underframe is shown in Fig. 2.

The center sills, side sills and end sills are made of 10-in. ship channels weighing 21.8 lb. per foot. The side sills are 36 ft. 2 in. long. There are 318 round holes of six different sizes to be punched in the face of the center and side sills and eight ends to be coped to fit the end sills.

I have devised an arrangement for punching and coping these sills by which the operations are all completed in one pass through the machine and which

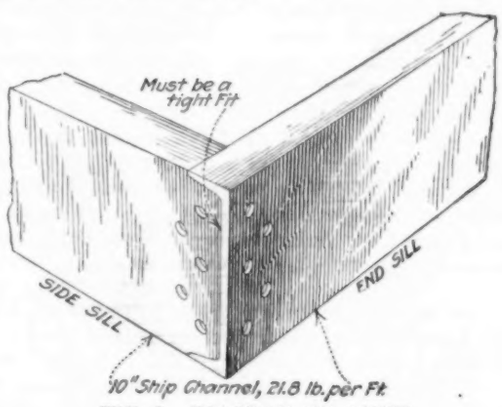


FIG. 2. DIAGRAM OF JOINT

should prove to be of interest to others who are building similar cars.

I am using a punching machine having a 3-in. stroke. The head and base are 36 in. square. Special die blocks *A* and *B*, Fig. 3, which were made of cast iron, and 17 punches are so arranged that all holes can be punched in any sill without shifting it sidewise.

As the channel passes through the machine it is gripped at either end by clamps on a traveling carriage, the rollers of the table being adjusted to the same height as the bottom of the die block *B*, thus maintaining the weight of channel. The coping operations do not use the carriage.

For the first operation the channel stands up edgewise with the end under the square cope knife at the back of the machine.

The cut-out part of the top die block *C* is to clear

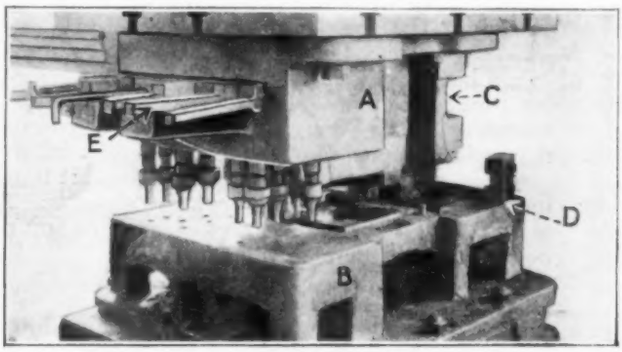


FIG. 3. ARRANGEMENT OF GAG PUNCHES AND COPING TOOLS

the top flange of the channel while the bottom flange is being cut. For the second operation the channel is turned over and the other flange is cut with the same knife. The top knife is shown at *D* in Fig. 3.

The third operation is coping the face of the channel, which is done at the center of the head, the blades for this cut being shown in Fig. 4.

After coping the first end, on the left side of the machine, the channel passes through the machine at the front, where the holes are punched. The other end is then coped on the right side of the machine, making the sill complete. On this last operation the sills are gaged from the end already cut, as they must come to the exact length.

The punches are arranged in seven rows and have eight gags as shown at *E*, Fig. 3. One, two or three holes are punched at each stop of the carriage. The channels are marked from a wooden templet so as to insure punching all the required holes.

There is a 6-in.-square guide between the flange copes

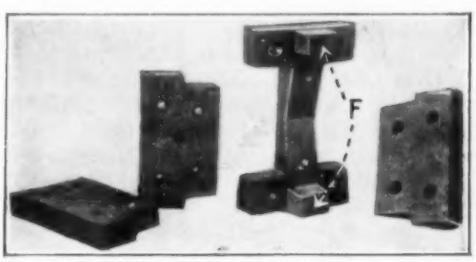


FIG. 4. TOOLS FOR COPING AT CENTER OF SILL

on top the head and it extends down into the bottom block. The raised parts *F* in Fig. 4 also serve as guides to keep the male knife from springing, since only one side is used at a time.

Two sets of face-coping knives are required, the center sills being coped $\frac{5}{16}$-in. deeper than the side sills, because they meet the end sill at an angle.

The Solution of the

WHY should Uncle Sam be content to dispose of his war-purpose machine tools at a loss when he can dispose of them at a profit to their owners, the public, of 1000 per cent. or more?

We have seen a number of plans put forward for the disposal of these tools, varying in practicability from one similar to the rumored method of disposing of the German fleet by sinking it in the ocean, to a more sensible, if hardly more profitable, one of allocating these surplus tools back to their own manufacturers for disposal through them to the public.

All of these plans entail a distinct loss to the public pocketbook and present no possibilities of getting back the first cost of these tools, to say nothing of making a profit on them. The types of tools that have been purchased for war purposes, by virtue of their intended use, have been those with which every machine shop at home and abroad is fairly well supplied for peace purposes. For a long time to come even the most sanguine can expect no great demand for these types of tools. Thus any plan that contemplates putting these machines into the market must of necessity impose a long wait or a low price.

Neither of these things is desirable. A long wait means an accumulation of storage charges and an accumulation of depreciation, for depreciation often piles up at a faster rate when a machine is kept in dead storage than when it is kept busy. Low prices as a means of disposal of these machines are not in line with public interest, since by establishing a fictitiously low level of value for the article—a cut price, below cost-selling policy, in other words—they must inevitably lower wage standards.

There is a way to dispose of these machine tools so that they will earn tremendous profits for the United States.

That way consists of USING THEM TO EQUIP A NATIONAL SYSTEM OF TRADE TRAINING SCHOOLS, in which the mechanical talent of America can be fostered and developed.

IT is true that we have and have had technical high schools, trade schools and manual-training schools, but it is also true that the mechanical equipment of 99 out of 100 of these schools is on the average from 15 to 20 years behind the times. Handicapped as they have been by the necessity of training their students on equipment that the average manufacturer would consider fit only for the scrap pile it is a striking tribute to the value of industrial training that these schools have done as well as they have.

We must encourage trade training as a national policy, and particularly the training of MECHANICAL SKILL, which furnishes the means for the application and extension of skill of all other kinds. The prosperity of America is primarily and basically founded on the sum total of its industrial skill. As we have fostered and developed this skill in the past, and through its possession applied machinery and engineering to the development of our natural resources, so has this country prospered.

WE are an industrial nation. Our inventors, mechanics and scientists are in the aggregate our most valuable citizens, measured by their essentialness to material prosperity, and national material prosperity is the forerunner of progress of every kind. Eliminate these people from our social structure and you bring poverty, hunger and want upon every man, woman and child in America. You paralyze transportation, sever the farm from the city, shut down the coal mines, the steel mills and the factories, put an end to the lives of individuals and communities. Can you think of any other class of citizens the elimination of whom from our scheme of things would bring such chaos?

FOSTER the development of our mechanics, inventors and scientists, and in proportion as you do, so do you add to our national prosperity and individual well-being.

Material prosperity is absolutely limited by the quality and quantity of mechanical skill that exists in the community. All wealth comes from the development of natural resources, and this development is made efficient only by machinery. Mechanical skill gave us the low-priced automobile, the modern locomotive, the ocean greyhound, the sewing machine and the typewriter. Mechanical skill and machinery have given us every labor-saving device that helps to make the world's task an easier one.

During the quarter century previous to the war, mechanical skill and its result in the form of improved machinery caused wages to rise gradually and continuously, while at the same time the cost of manufactured products as consistently and steadily decreased. Mechanical skill has been and will continue to be the world's most potent factor in increasing the purchasing power of money.

War-Tool Problem

NEVER in our history have we needed more than we do now to foster and develop factor that will increase the purchasing power of our dollars. War has forced economic conditions out of balance. Why search for new and untried expedients for restoring this normal balance—for making the dollar as powerful as it was before the war—when we have at hand a means that has demonstrated its effectiveness during a quarter century?

That means is the intensive national cultivation of mechanical skill.

In normal times the development of mechanical skill through the individual efforts of states, communities and progressive manufacturers was perhaps sufficient for the needs of those times. But times now are not normal nor will they ever again be the same as they were before the war. Scattered efforts toward progress must be replaced by intensive, coördinated plans of nation-wide scope.

Double during the next ten years our sum total of mechanical skill and you will not only double our per capita wealth, but, more important, you will double the purchasing power of our dollars.

When you survey the collective inefficiencies of our present-day methods of industrial training you are confronted with an overwhelming sense of the possibilities of achievement through a coördinated plan. And the difficulty in almost every case has been the impossibility of securing proper equipment. Machine tools are expensive when they are modern and worth while. The average industrial community is without the means of obtaining trade-school equipment except such as has outlived its usefulness and productivity.

HERE is an opportunity for our farsighted statesmen to further immeasurably the material welfare of America. Here is an opportunity for Uncle Sam to outfit complete in every community a trade school which will not be a collection of antiquated junk, but will represent the last word in equipment.

Make these surplus machine tools, which everyone is wondering what to do with, available to the educational institutions of America.

Here is an opportunity for statesmen to foster the genius of a coming Watt or Fulton or Stevenson, and thereby to bring upon America the far-reaching benefits of invention. Here is an opportunity for the tens of thousands of American boys who by taste and instinct are unfitted for academic training in scholastic subjects, but who, born with mechanical instincts, can be trained to become valuable mechanics through the development of these instincts instead of being thrust at an early age into occupations of drudgery.

LET CONGRESS SECURE a committee of advisers from among the leading vocational educators of our various states. Let these educators pass upon the surplus mechanical equipment under Government control, eliminating from this such material as cannot be adapted to equip trade schools.

LET THE REMAINDER OF THIS EQUIPMENT which *can* be adapted to equipping trade schools be withdrawn from the custody of the various Government departments that now have it in control and placed in the custody of a national board of commissioners for a period say of two years.

LET THESE COMMISSIONERS pass upon requisitions duly made out by accredited boards of education, universities or colleges that desire to equip trade schools in their communities. Let it be understood that the requisition from any community must be accompanied by satisfactory evidence of the availability of a building to house the machinery and of the assurance of the necessary funds to maintain the trade school.

After the two years or other predetermined period has expired let such machine tools and equipment that have not been requisitioned be disposed of in the market according to one or more of the plans now proposed.

He is a wise investor who places his assets for future profit instead of sacrificing them for present loss. Here are these tools which the Government has bought and paid for—these tools that by their very prevalency, which makes them difficult to sell, makes them exactly suited for training purposes. Let us not sacrifice them at a loss but invest them for a profit.

WE have been behind Germany in preparation for war; we have been behind England and France in preparation for peace. Here is the opportunity for our statesmen to reclaim the American title for progressiveness by using this material that is at hand to establish a broad foundation for enduring prosperity.

How Uncle Sam Will Help Solve Your Export Problem

WITH the kaleidoscopic changes created by the automatic retirement of war-time committees which so ably functioned for our Government during the war industry finds itself relaxed from its extraordinary efforts and is today confronted with readjustment.

Priorities and Government price control have been abandoned and the most practical methods of transposing production from a war to a peace basis which will still maintain employment and wages are being sought.

Many efforts and suggestions have been advanced along the line of export organizations which have been made possible by the Webb-Pomerene bill which permits of the combination of manufacturers for new business in foreign lands, but comparatively few of our manufacturers possess a fundamental knowledge of the necessities for conducting export business.

Previous to the war and owing to the conditions existing in the mercantile marine the greater proportion of the manufacturers of this country did not seek foreign markets and most of those who did held to a rigid system of credit protection. It is a sad commentary on the actions of a part of American industry that in Latin America an erroneous impression prevailed as to the integrity of America's business methods. But the world war transposed these conditions with the closing of the markets of Europe, and our own trade with the 20 countries of South America increased from the year 1913-1914 from $750,000,000 to $1,750,000,000 in 1917-1918, or 253 per cent.

Our larger banking institutions, principally in New York City, established branch offices in all of the countries of South America and the natives of these various countries have come to appreciate the service offered them by our own financial institutions. This places us now in a position to do business on a credit basis, and, with our merchant marine, we are today in a position to compete as never before for this desirable business.

While American manufacturers have been deeply engrossed in their production of war-time requirements there apparently has been overlooked the available information at hand in our own Government agencies. Appreciating the extent and helpfulness of this information the *American Machinist* presents in this issue a diagrammatic chart of information prepared by the Bureau of Foreign and Domestic Commerce, which is

BUREAU OF FOREIGN AND DOMESTIC COMMERCE
FOREIGN TRADE PROMOTION
RESEARCH
Foreign Tariffs
Information concerning foreign tariff and customs laws and regulations, commercial policies of foreign countries, foreign trade-marks and patent laws, embargoes and import prohibition, and foreign consular regulations.
Research
Supplies information on import and export statistics of all foreign countries, foreign sources of supply of raw materials, translating, and researches in all phases of foreign trade.
Statistics
Supplies information regarding import and export statistics of the trade of the United States with all countries. These statistics are furnished in ten-day, monthly, quarterly and yearly periods.
Far East
Information regarding ports and transportation facilities, investment opportunities, mineral resources and their development, and the markets for cotton goods, wearing apparel, railway equipment, motor vehicles, shoes and leather, etc.
Latin America
Information concerning markets for American products, regulations for guidance of commercial travelers, trade conditions in Latin America, specific openings for American exports, and concerns which might act as representatives of American exporters.
ADVICE AND INFORMATION
FIELD WORK
Correspondence
Furnishes American exporters information on markets in foreign countries, including advice on methods of packing, financing export shipments, sources of foreign credit data, lists of importers abroad, and names of domestic manufacturers.
Editorial
Makes available to the business public, through publications and indexes, information on commercial and industrial conditions in all parts of the world.
District Offices
Miniature bureaus at New York, Boston, Chicago, St. Louis, New Orleans, San Francisco and Seattle. Recognized centers for reliable information regarding domestic and foreign trade. Render special service to foreign buyers seeking goods in the United States, and adjusting trade differences.
Commercial Attaches
Located in the principal capitals of the world, furnish first-hand information and advice on banking, commercial, industrial and investment conditions abroad.
Special Agents
Technical trade investigators who study foreign markets for specific American commodities, also assist American manufacturers and exporters to establish satisfactory trade relations with particular foreign importers.
Trade Commissioners
Men with commercial and economic training who study general trade conditions abroad, with particular reference to increased sale of American products, supplying of raw materials necessary in American industries, etc.

self-explanatory and which portrays the extensive plans of the Department of Commerce in its efforts to serve American industry.

The thoroughness of this foreign-trade service has been outlined in the annual report of the chief of this bureau. All of the information stated in the chart is available for those interested in foreign-trade expansion.

Application for information regarding export business should be addressed to the Bureau of Foreign and Domestic Commerce.

Definite Work for War-Service Committees

AT THE meeting of the Council of War-Service Committees of the National Chamber of Commerce, held at the Waldorf Hotel Jan. 3-4, President Wheeler said:

I have had this feeling about the meeting of the council. At Atlantic City you asked that we should have a meeting at the earliest possible moment to try and get our bearings and relate ourselves together as a new organization. The organization is loose we will have to admit. It has to evolve out of what it is today into the useful machinery it must become, and we cannot expect in a meeting of this kind to develop just what the council will constitute as a force in this country either in relation to the respective industries that are here represented or the business interests of the country as a whole. It was unfortunate that we should have to call a meeting just at this time. It is not an appropriate time to get together. Things are more or less in a state of flux everywhere, and we cannot drive quite as substantially to a common program and definite center as we may be able to do a few weeks from now. In consequance there is more or less embarrassment both in respect to the War Service Executive Committee in calling the council together and in the council's deliberations.

But I want to give you just this word. We have 60 days in which to do intensive work, and if we spend 60 days in completing a perfect piece of machinery we would find the machinery all set up and no opportunity to operate it. The thing that now is necessary is not so much talk but a lot of action, and I have felt that you would be better off for having come into this meeting with your War-Service Executive Committee constantly on the job in Washington, as it will be by sections if not as a whole, there watching your interests and flagging out to you from this time on whatever we think you ought to have relating to your respective industries. But that War-Service Executive Committee is incapable of doing all the work that is going to be necessary in connection with this readjustment. It is up to the War-Service committees to flag into the executive committee in Washington the things that your industries want consideration for and all suggestions that you may have to make that we must pass on to the necessary authority, whatever that may be, in order that there may be coördination between the War-Service executive committee and these War-Service committees that will work intensively during the next 60 days in order to clear up things in our minds which we have not been able to express quite clearly now.

I found in the last few weeks in the many War-Service committees organized, some representing war and some nonwar industries, the question arising as to their relationship to this central body. The nonwar industries say, "We are going back to peace production, and restraints and restrictions are being removed and we have no war orders and no special relationship to the war program, so what relation have we to this council?" The answer is this: This is a council representing every industry in the United States through its War-Service committees charged with the responsibility of safeguarding those industries.

The industries that are particularly beset with problems that have arisen out of the armistice and cessation of war vitally need the support and wise suggestions of the War-Service committees in behalf of every unit of the industry. These industries that are so-called nonwar industries that have not been related to the war program except as to conservation measures and restrictive measures are getting back to normal operations, but are tremendously interested in the fact that if any industry is beset by the problems of today or depressed by conditions that depression relates to every industry and becomes a direct menace to the nonwar industry just as much as the war industries.

In this matter we are absolutely a unit. Unfortunately we are unprepared for the conditions that now confront us. Unfortunately we are always thrown into a new situation without the opportunity of building machinery as other countries have been taught to build theirs. It is the old American policy of tackling the thing when it is on our backs and getting out from under the burden with as little disruption as possible. That is our situation today. We must approach this gulf immediately before us with intelligent action and get over into the period of prosperity which is on the other side of the gulf and will last for several years and which will give us the opportunity of bringing about changes necessary in legislation, the reconstruction of our economic forces and transportation agencies and return to private ownership of those agencies and adjustment of other factors which we cannot do today in the short session of Congress. At this time we must concentrate on the immediate problems of validation of contracts. My judgment is that your War-Service executive committee will do the best that a group of men can possibly do for you, with or without your constant suggestion and coöperation and good-will. But your War-Service executive committee will be multiplied in its power and force if every chairman and vice chairman of a War-Service committee will get his War-Service committee together at the earliest possible date and will study the problems of its industry and let us know the things that the industry is suffering from or likely to suffer from and suggestions that are necessary for its safeguarding.

Constructive suggestions of a national character we need in order that we may be better able to map out the program necessary in Washington, and then by the time this council is next called together we will have a definite, concrete, constructive program to put up to you for discussion and to carry back to the industries in a way that we cannot do today.

We will drive to three central problems which are immediately before us. We want these contracts that are informal validated, and we want aid given to some units of industries now desperately in need of assistance in order that there may be no distintegration in any industry or any unit of industry. We want the question of the resales of property of whatever character delayed and put in the hands of a proper agency so that the departments that now have the control under the law shall understand that these goods are not to be offered promiscuously in the market until such time as we are ready to absorb them without destruction of new production; and in that matter generally one of the strongest factors we can have to support the creation of proper agencies for the distribution of those materials will be labor, as labor is most vitally interested in this matter, for if through uncertainty depression and a resulting cessation of business occurs, because of not knowing what is going to happen on the morrow, and with this great mass of stuff uninventoried and with unfinished war contracts, labor necessarily will be laid off, for there is no production possible under such conditions that will parallel the production of the war period. Labor thus finds itself in a disagreeable position, and we will have to depend upon our forces of industrial production and the forces of labor to combine into a body that shall insist upon legislation necessary for the creation of agencies necessary to bridge us over this period of the next few months.

Oversea Commission to Be Chosen

I want to talk to you about another thing. You wanted that there should be a commission created to send over to the other side, and I think you are entitled to a statement on that matter, for it is something the council is interested in. We could have taken up your suggestion and created a commission; have had it ready at this time to proceed to the other side with an indefiniteness as to program and purpose that would have been unfortunate and might have made for conflict. We have, on the other hand, taken this course. We have been in constant consultation with the administration and by cable with interests on the other side of the water to try and ascertain as nearly as may be at this time the precise conditions that exist over there.

There was no desire on our part to create an agency representing American industry on the other side that would conflict in any way with the practical development of the official agencies that are likely to be created by our Government work and with other governments. The con-

sequence is this matter was handled in this way. We are ready to proceed with the creation of a commission representing American business at the very moment that it seems necessary and desirable to create it and start it across to the other side. We want first to ascertain, and we will know within the course of the next two weeks, precisely what the requirements are and what our own administration and our own business confrères shall agree on as the procedure we should adopt in order to conform so far as possible to the needs they themselves have in mind.

If we find that our own administration in charge of the negotiations will create a suitable and competent and representative group and feel that group can work not under restraint but freely we obviously will tie to that group as our representation. If, on the other hand, we find that official representation on such a commission as may be created cannot freely represent American industry, would operate under certain restraints because of its official connections, and that commission, aside from the official commission necessary to go over there with freedom of action and speech and report in order that American industries may be flagged with the latest information of a correct character, we will supplement such body with a body of our own that will operate without restraint.

Best Means of Accomplishing Purpose

That, we think, is the best means to accomplish the purpose you had in mind at Atlantic City, and within the next two or three weeks we will have information for you as to the course that should be pursued in order that American industries shall be properly represented, if not officially, then unofficially, but so related to the official group that there will be no conflict and there will be freedom of action; and information you want for the safeguarding of your industries will be available to guide you in future operations.

I have a very great desire to see this council take its proper place in the work that is just ahead of us, and it can only take its proper place if each chairman or vice chairman of the respective War Service committees shall function as earnestly in the unwinding of conditions as it functioned in the winding up of those conditions.

Mr. Butterworth said we have been brought up to a certain peak by conditions that have forced us to it and under influences that have been difficult and forced sacrifices on the part of many, and readjustment and reconversion on the part of many is necessary; we have been brought up to this peak and left there, and we have got to either fall off and get bumped or get down by gradual processes in a manner that will bring us to the normal level without the disruption that would come from a sudden fall. The industries themselves know what they ought to have. The War-Service committee of each industry can best advise the safe method of return to normal.

Your War-Service executive committee will stay in Washington and work for you, but you must tell us what you want and indicate the dangers that confront you and give us the aid without which we cannot function effectively and to the fullest extent in your interest. Many problems will come up later on. After the present session of Congress adjourns we will have to call upon this council, possibly drawn together in some different form of organization than today's, to advise us on matters regarding the passage of legislation of economic character that cannot possibly be considered at this time, for we would now scatter our forces so as to make impossible the accomplishment of the things immediately necessary. Keep your War Service committees together and have them meet as soon as you can for the discussion of problems of each industry. Give us a digest of your findings so the War-Service executive committee may have constantly coming into Washington the latest and most effective and complete advice with respect to the manner in which the industry is functioning and the dangers as you see them.

We, on the other hand, will pledge that as rapidly as there is anything in which you are interested takes place in Washington and as rapidly as we see a place where the War-Service committees can exercise force to bring about the things necessary to a return to the proper basis of operation of all industry we will flag it out to you, and you can then exercise your influence with your industries to support these things.

It is altogether a difficult situation. There are very many complex conditions. We cannot have all laws repealed and new ones completed in a short time. We must utilize the machinery that exists now and supplement it by new machinery that can be quickly installed. If we stick together as the units of American industry and as War-Service committees representing all those units for the next 90 days in intensive work on behalf of the difficult conditions that exist we will bridge definitely a gulf that will put us over into a period where for three or four years we will not only have prosperity in this country such as we have not seen for many years, but we will be able during that period of prosperity, coöperating together, to wisely adjust the elements of production so that in any subsequent period of depression we will be prepared to cope with that period rather than have it come upon us as suddenly as the cessation of war came upon us.

We want to have the broadest policy with the agencies of the Government which are trying to function with us. Our industries' needs cannot be known by the agencies except as we give them the information. We want to be generous in our opinions of what they do and we want to be friendly and open with them in our representations to them. Out of this council and of the emergency of the war and out of the coöperation between Government and business that has resulted during the period of the war, and out of the new vision which the public itself has been bound to get of the unselfish effort of American business to advance the war program, have come the complexities of the present moment, because we have waited for no complete contracts. We have only asked to be told what it was necessary to do to win and we have accomplished that to the best of our ability.

The American public, knowing that, has today a different concept of the relation of industry to the Government and of the broad spirit in which industry has operated than it has had for 15 or 20 years. Into this organization and our committees together let us gather our information impartially and honestly for presentation to the agencies that need it and hold ourselves in readiness for service, because the armistice signed or the peace treaty ultimately signed does not mean a release of the war efforts of the agencies that have been in this problem until such time as we have safeguarded the return of industry back to normal operations as before the war.

Our task is only begun. We have got to function through until normal conditions are again with us and until we have solved the difficult problems up to today and have controlled the complex conditions which now confront us and have enabled us to return in safety our industries to their normal position and have again come into relationship with our labor which will be that relationship which must continue during the period beyond the period of readjustment.

Chamber to Aid Readjustment

Just a word as to the chamber. The Chamber of Commerce was organized six years ago at a time when war in the world was considered impossible, because we were led to believe that finance, commerce and industry generally would make impossible the chaos that has resulted in the last four years. We have learned many things about organization. We have learned many new angles of the industrial situation and much of coöperation we did not know before. The chamber will be your servant to make every trade organization as nearly 100 per cent. strong as it may be made in these months that are immediately ahead of us, until trade organizations representing American industry can be largely representative of the whole industry.

You may command us for any service that you think we can render, for any influence that units of the industry think they need with those who have not seen their way clear to associate with you; to come to meetings whenever called and exercise all the power and influence we can exercise in order that the industrial organizations of the country as represented by the trade associations shall be as nearly as possible 100 per cent.

You can trust us further, that the chamber functioning in that way for you will endeavor to make such readjustments of its own machinery as to make a central agency that shall be able to speak as representative of all the agencies of commerce, whether they are agencies of production or distribution or foreign trade or what not, in such fashion that you may be able to rest your case with this central agency which we together have been able to create.

There is a tremendous work for us to do. It is not going to be a work that will ever be done by speeches. It is only going to be done by intensified action. So far as I can pledge the chamber I pledge you its whole efforts to bring about the conditions that are necessary to safeguard industry and restore it to normal conditions, and I ask of you that, having placed in the hands of the chamber this difficult task to perform and having made it necessary for men to still further absent themselves from their own busi-

ness to carry out for you the program you have got in mind for your industry, you will within your industry stay together and hold your organizations exactly as they are, making them operate intensively during these next difficult months and support the chamber in its effort to bring about the conditions you desire.

We want your help for part of this program. We are going to make a part of the program anyway, because there is a determination to use the influence we possess and all the powers we possess to bring about conditions that we know ought to exist; but by united action of the organization which we have in Washington and the organizations that you have in your respective industries we can move across this period that immediately confronts us and into the future with confidence that whatever may come we shall bridge the present dangers safely and safeguard our industries over the gulf we are approaching.

Mr. President, if it should arise in the subsequent meetings of this council and in your deliberation that you should find a substitute machinery in place of the War-Service executive committee as now constituted by your order at the Atlantic City convention, will you let me state to this body that the Chamber of Commerce through that War-Service executive committee will hold its place and perform its work to the best of its ability and with as much unselfishness as it can until the new machinery might be ready to operate.

If at any time American industry as represented by the War-Service committees should find that it can create a central committee that will function better than the committee that you have now functioning for you we will gradually pass back into our own affairs as your committee passes on, thanking you for the opportunity of being relieved of a task which we are doing as best we may in your interest, but which we will relinquish to better machinery as soon as you are ready to supply that machinery. In the meantime, beginning Monday, you will find the War-Service executive committee in Washington in your interest and when we flag back to you the fact that we need your support and that every unit of your industry should be rallied behind a movement that is necessary in obtaining legislation for the erection of machinery necessary to negotiate this period we are going to expect you will be on the job and give us the support we need in order that your own interests may be properly carried on.

Payment for Informal Contracts

As was to be expected there is every reason to believe that Congress will soon pass a bill legalizing such war contracts as were accepted and conducted in good faith but which were not made in the manner required by law. The Committee on Military Affairs has recommended-the passage of the following bill (H. R. 13,274):

That the Secretary of War be and he is hereby authorized to adjust, pay or discharge any agreement, express or implied, upon the basis of reasonable value, but in no case greater than the agreed price, that has been entered into in good faith during the present emergency and prior to Nov. 12, 1918, by any officer or agent acting under his authority, direction or instruction with any person, firm or corporation for the acquisition of lands or the use thereof, or for any supplies, material or equipment to be used in the prosecution of the war, when such agreement has been executed in whole or in part, or expenditures have been made or obligations incurred upon the faith of the same by any such person, firm or corporation prior to Nov. 12, 1918, and such agreement has not been executed in the manner prescribed by law;

Provided that payment under such agreement shall not exceed the fair value of the property transferred or delivered and accepted by the United States, as determined by the Secretary of War, and where no property has been transferred, delivered or accepted payment shall not be in excess of the actual cost incurred in preparation for performance as such cost is determined by said secretary:

Provided that this act shall not authorize payment to be made of any claim under such agreements after June 30, 1919;

Provided further that the Secretary of War shall report to Congress at the beginning of its next session following June 30, 1919, a detailed statement showing the nature, terms, and conditions of every such agreement and the payment or adjustment thereof;

Provided further that nothing in this act shall be construed to confer jurisdiction upon any court to entertain a suit against the United States upon any agreement of the character herein provided for;

And provided further that no settlement of any claim arising under any such agreement shall bar the United States Government through any of its duly authorized agencies or any committee of Congress hereafter duly appointed from the right of review of such settlement nor the right of recovery of any money paid by the Government to any party under any settlement entered into or payment made under the provisions of this act if the Government has been defrauded, and the right of recovery in all such cases shall extend to the executors, administrators, heirs and assigns of any such party or parties;

And provided further that nothing in this act shall be construed to relieve any officer or agent of the United States from criminal prosecution under the provisions of any statutes of the United States for any fraud or criminal conduct;

Provided further that this act shall in no way relieve or excuse any officer or his agent from such criminal prosecution because of any irregularity or illegality in the manner of the execution of such agreement.

Provided further that the names of such contractors and the amounts of such partial or final settlements shall be filed with the clerk of the House for the information of Congress and printed in the "Congressional Record" or in the "Official Bulletin," or as a public document, 10 days before confirmation, and payment is authorized upon such contracts.

Government contractors and subcontractors representing $1,500,000,000 met in Cleveland recently to discuss the facilitation of such action, which now seems to be assured.

The Need for Mechanical Training

BY LUTHER D. BURLINGAME

During the war one of the most serious needs, and one most difficult to supply, was that of unskilled labor. This was due not only to the demands of the war industries and the withdrawal of large numbers for military service, but also to the stopping of immigration.

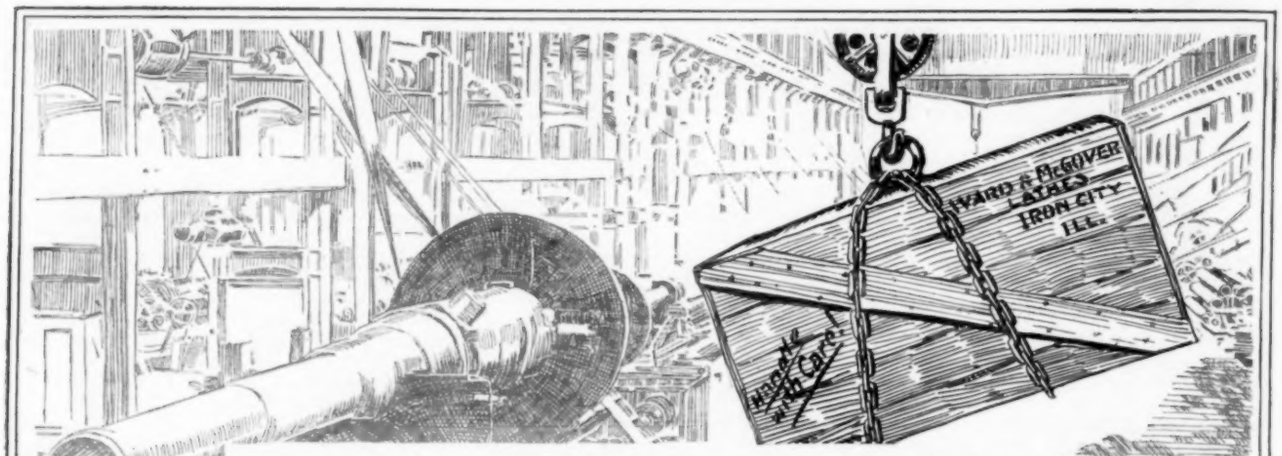
While there is a wide difference of opinion as to immigration following the close of the war it is evident that when settled conditions return in Europe large numbers of foreign-born workers in this country will return home, and while in some cases this may be temporary, to find and help relatives and friends, it is probable that many will stay to help in the restoration of their home countries.

It is also probable that immigration from countries that have furnished most of it in the past will be held back, and there will probably be a departure of the foreign born now here.

To overcome this labor scarcity an effective way would be the introduction of labor-saving devices, machines and methods for performing unskilled work, which would permit one workman to perform the tasks of many.

The story has been told of a French army officer who had won a medal for bravery being at a loss to know how to adjust his relations with his valet following the war, as he did not see how he could ask him to polish his shoes when the valet had won the Croix de Guerre. What an opportunity for exploiting nickel-in-the-slot shoe-polishing machines in France!

The supplying of mechanical aids is a direct field for inventive ingenuity and for business enterprise, which if worked out will give stimulus and prosperity to the mechanical trades.

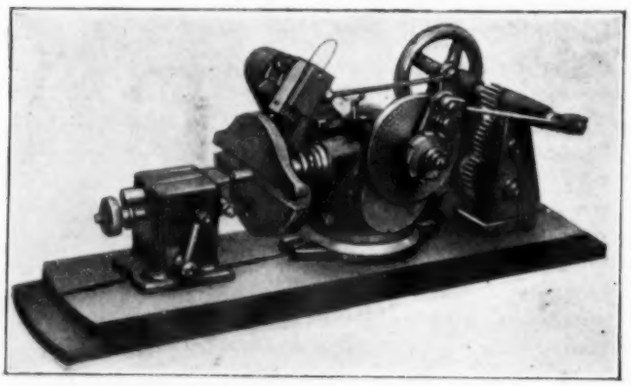


SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Schipper Graduating Machine

The Schipper Machine and Tool Co., Aurora, Ind., is making the graduating device shown. It is an attachment fitting the 10-in. universal index head made by the company. It will graduate disks or dials at any angle from 45 to 90 deg. inclusive. It will graduate parts up to 10 in. in diameter, cutting four short marks and one long



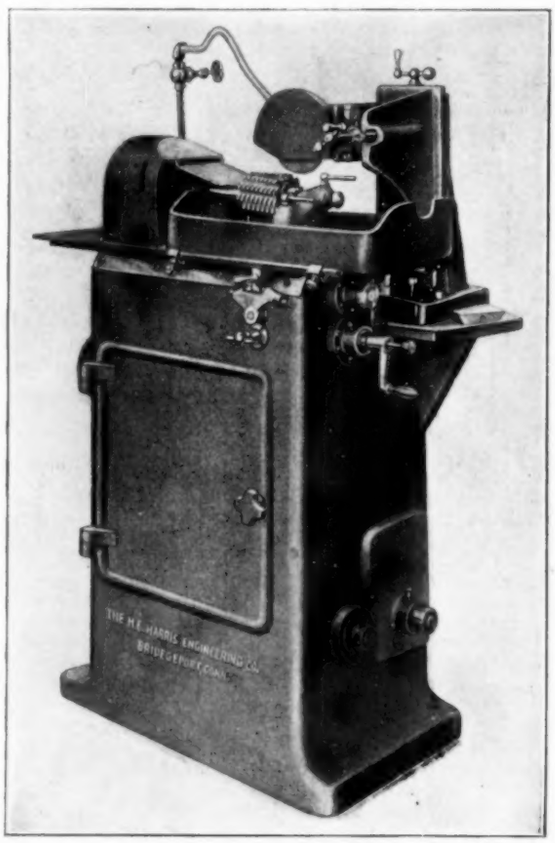
SCHIPPPER GRADUATING MACHINE

one and repeating automatically as the handwheel is turned.

The device can be mounted on a milling or planing machine table or a bench. It weighs complete 110 lb. and when not needed is easily detached from the index head, which can then be used for other work.

Harris Automatic Universal Hob and Form Cutter Grinding Machine

The illustration shows the new No. 4 automatic universal hob and form cutter grinding machine that has recently been placed on the market by the Harris Engineering Co., 1047 Broad St., Bridgeport, Conn. It is claimed that hob-grinding work may be done on this machine with lower-priced labor than is ordinarily used for this purpose and the points of advantage of the machine cited are as follows: Hobs and form cutters can be accurately and evenly ground. The amount of material ground away at each stroke of the machine is a minimum and therefore crowding and its attendant heating and burning are avoided. Flood lubrication is used, avoiding overheating. The speed at which the



HARRIS NO. 4 AUTOMATIC HOB AND FORM CUTTER GRINDING MACHINE

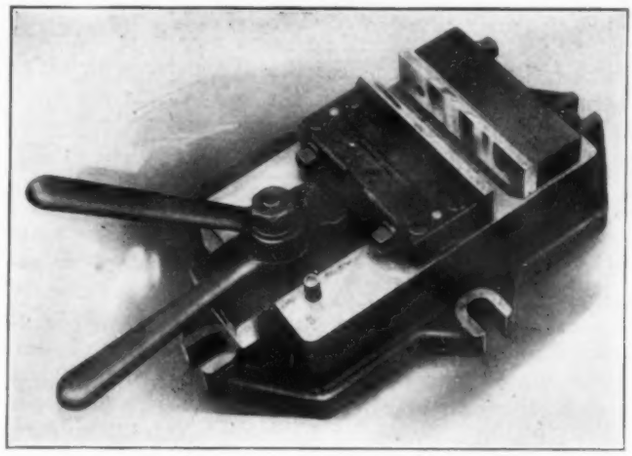
hob or form cutter is fed to the grinding wheel is constant and an experienced operator is not required, and the machine being automatic in action the operator can run it in connection with other work. Setting up operations are simple, thus avoiding the tendency to use

hobs or form cutters until they are excessively dull. The machine may be used for salvaging milling cutters by regashing the teeth and will grind any form cutter or hob within its range, including radial mills, fluting cutters, gear cutters, irregular form cutters, hobs for female-thread gages, dies, etc., hobs for worm wheels, hobs for gears and other such work. The grinding spindle runs on ball bearings and is provided with micrometer adjustments in both horizontal and vertical directions. The wheel is covered with a guard into which the lubricant is fed. After being used the lubricant drains from the wheel and the work into the pan surrounding the table from where it runs back into the tank located in the column. The work is carried between centers on a reciprocating table provided with an adjustable stroke. The table carries the necessary means for setting and holding the work and also carries that part of the indexing mechanism which indicates and clamps the hob or form tool in position for each double grinding stroke. It is interesting to note that a device has been incorporated to prevent back lash to permit grinding on both the forward and back strokes of the machine. The operating mechanism for the indexing is contained in the column below the table and is timed to coördinate with a mechanism for the table movements. The automatic mechanism for operating the table can be instantly connected or disconnected at any time by means of a positive clutch operated by handle within reach of the operator.

All wearing surfaces are provided with adjustments for taking up wear and are protected from dust and particles of abrasive. The wheel head, together with its slides, idlers and other mechanism, is placed on a large circular mounting at the rear of the machine, this allowing the wheel to be swung and clamped at any angle desired. This movement does not affect the axial position of the wheel in relation to the work, but adapts the wheel to suit the spiral flutes to be ground. The spiral mechanism is mounted at the rear of the machine and operates directly on the arbor, an adjustment being provided for the amount of spiral required. This adjustment is so made that it can be quickly set for a cutter, the spiral of which is not known exactly. It is possible by means of transverse adjustment of the wheel to grind the faces of the teeth radial, with an undercut or rake, or at an obtuse angle. The amount removed from the face of the teeth is controlled by rotating the hob slightly in relation to the indexing mechanism after each complete revolution, an adjusting screw being provided for accomplishing this movement. This insures the shape of the tooth being the same no matter how much material is taken off. The machine is also adapted for special work in which it is necessary to use formed wheels and may also be so arranged as to back off the teeth of taps at the cutting end.

Hartford Quick-Acting Milling Vise

The Hartford Special Machinery Co., Hartford, Conn., has recently placed on the market a new 5-in. quick-acting milling vise. The parts of the vise are made of drop-forgings, casting and bar stock, and are machined all over to gages to permit interchangeability. All fitting and sliding surfaces are hardened and ground and the sliding jaw is scraped to the base. In the sliding

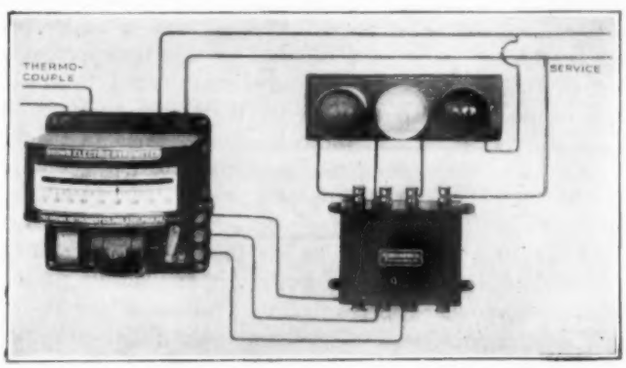


HARTFORD QUICK-ACTING MILLING VISE

jaw is a T-slot which receives the head of the bolt carrying the bearing, which has serrations to engage those on the sliding jaw. The eccentric of the binder handle fits in the cam handle and both swing on the same bearing, which is clamped to the jaw by the bolt. In operation the sliding jaw is adjusted to the work by clamping the bearing in its proper place. The cam moves the jaw up to the work and partially clamps it, while a movement of the eccentric gives a final tightening.

Brown Automatic Signaling Pyrometers

In most plants where pyrometer equipment is used it is customary to use three colored lights to indicate the temperature to the furnace operator; one light is for too low a temperature, the second for too high a temperature, while the third indicates the proper temperature. This system ordinarily requires the maintenance of a central operator to flash the signals and considerable other apparatus. In order to save the expense of the operator's time and the elaborate installation the Brown Instrument Co., Philadelphia, Penn., has recently placed on the market a new automatic signaling pyrometer. A contact table that is adjustable throughout the whole scale range carries three contacts corresponding to the three lights, the pointer on the pyrometer being automatically depressed once a minute on the tungsten contacts. An automatic three-position relay is operated by the closing of the contacts in the instrument. This closing of the contacts lasts but a few seconds, the relay serving to keep the proper light in operation at all times. In case it is desirable to be able to read the temperature



BROWN AUTOMATIC SIGNALING PYROMETER

of other thermocouples besides the one being automatically signaled a hand-operated switch is installed that can be used to connect the pyrometer with other thermocouples. In this case the relay keeps the same light burning at the furnace being automatically signaled until the pyrometer is again connected in circuit.

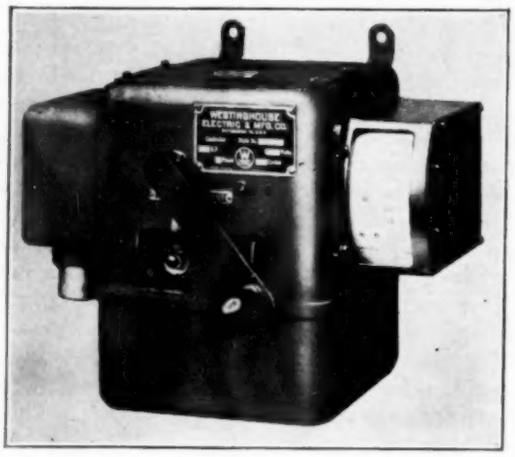
By introducing an automatic motor- or clock-driven switch in connection with the pyrometer the temperature of practically any number of thermocouples can be automatically signaled by one instrument. Standard instruments are furnished for operating up to 12 furnaces in this manner, this method eliminating the expense of maintaining a central operator and an elaborate installation of a switchboard and hand-operated signal lights.

Another recent improvement that has been developed is an automatic advancing mechanism for the contact, this device causing the contacts to advance at a predetermined speed across the scale. This is claimed to be of great advantage in certain processes like kiln firing where the temperature must be advanced slowly at a predetermined rate. The same type of instrument is also supplied for automatic control of temperature either with electric switches for electric furnaces or with valves for steam, gas or oil. The automatic control can be so installed as to maintain the temperature at a given point or to advance it at a predetermined rate.

Westinghouse Quick-Make Motor-Starting Switch

The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has recently placed on the market the quick-make motor-starting switch shown in the illustration. Its characteristics are 10 to 100 amp., 25-hp. maximum, three-phase, 220, 440 and 550 volts. The device may also be used to control feeder circuits and is supplied in any of the following combinations, each having the quick-make and quick-break feature for either hand or shipper-rod operation: Nonautomatic switch, switch with low-voltage protection, switch with inverse time element overload protection, and full automatic switch with low-voltage and inverse time element overload protection. It is said that the switch is particularly suitable for shipper-rod operation on account of its positive action, it being impossible for the operator to retard the motion of the contacts after they have started to close. The contacts, which are opened or closed in oil, are made very quickly, and the rolling action confines the arc to the tips and prevents pitting.

Drawn-steel construction is used to give maximum strength with light weight and to assure uniformity and interchangeability of parts. The oil tank is supported by snap ring latches, the removal of this tank exposing the contacts. The contacts and contact supports are of the same construction used in Westinghouse type A auto starters and magnetic contactors. Micarta insulation is used throughout and openings are provided for conduit wiring into the top of the case. Overload and low-voltage attachments may be added without change in the switch mechanism as the toggle trip is common to all combinations of the switch. Low-voltage protection not only opens the contacts on failure of power, but makes it impossible to close them again until the return of voltage. Since the low-voltage coil is connected in the line circuit continuously means have been provided to close the armature of the low-voltage circuit when the switch is in the off position, thereby giving protection to the coil and preventing burn-outs. A safety stop may be provided by connecting one or more push buttons in series with the low-voltage coil. The overload relay is the same as that used on the Westinghouse type A autostarters, and has the inverse time element feature and is equipped with a regulating device, adjustment of which controls the degree and duration of the overload possible on a motor or feeder circuit. A hand reset is an additional safety feature that makes it necessary to set the mechanism before the switch contacts can be closed. After having been opened through the operation of the low-voltage coil, the overload relay or by moving the switch handle to the off position it is impossible to close the contacts again until the switch handle has been moved to the reset position, this feature protecting workman and machinery as well against the accidental starting of the motor.



WESTINGHOUSE QUICK-MAKE STARTING SWITCH

Demands for Industrial Physicians Growing Rapidly

The demand upon the newly established Working Conditions Service of the United States Department of Labor for industrial physicians and surgeons has grown so rapidly that the service has been compelled to establish a bureau of registry of physicians specially skilled in this growing phase of medical and surgical specialization.

The new registry bureau is prepared to furnish industries with the names of skilled industrial medical advisers on request and hundreds of physicians are listed in the Government's registry bureau in Washington and hundreds are being added to the registration files.

In each instance the service satisfies itself of the training of the physicians before their names are allowed on the list. In this manner industries are assured reliable information from authorities who have studied industrial problems with expert training in hygiene, sanitation and related subjects.

Employers and employers have expressed approval of the plans inaugurated by the Working Conditions Service and have shown a desire to coöperate in the establishment of factory-hygiene department.

LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft • Motor Trucks • Tractors

The Simplex Automobile Co., New Brunswick, N. J., was bought by the Wright-Martin Aircraft Corporation on Dec. 23, 1918.

In the 3 per cent. revenue tax the United States Government received $23,981,368 from automobile manufacturers for the year ended July 30, 1918.

The Senate Finance Committee has passed the new war-revenue bill with the elimination of the 5 per cent. tax on the sale prices of motor trucks, motor-truck trailers and tractors.

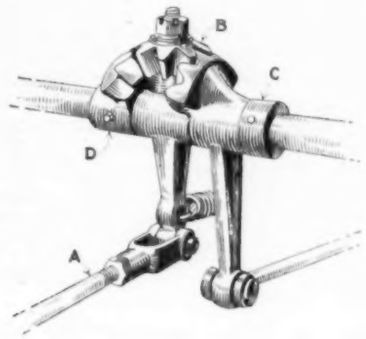
A new endurance-flight world record of 32 hours in a nonrigid dirigible balloon was established by Ensign T. E. Maytham at the United States Naval Air Station at Key West, Fla. Six hundred miles were covered before a leak and a threatening storm compelled landing.

A big exhibition ground has been established on the Champ de Mars, Paris, where the French military authorities are selling 1134 trucks, 1655 light trucks, 2884 touring cars, 1826 motorcycles and 2145 units, such as motors, transmissions, etc. Up to the present these sales of war-worn automobiles have enriched the state treasury to the extent of more than $6,000,000.

A feature of the new La Crosse tractor, model G, is the line drive. To the automatic-type steering gear a line-drive device has been added so that the tractor may be stopped, started and steered by the pull of the lines from the seat of any horse-drawn implement. The tractor is an open design and is burning kerosene by using a Kingston carburetor and a Bennett air cleaner.

The Fiat Co., Turin, Italy, will be represented with four new models on the market, two models with a four-cylinder Monobloc engine 8-12 and 12-16 hp. and two with six-cylinder Monobloc vertical engines 25-35 and 35-45 hp. Interesting features of these models are the adaptation of detachable cylinder heads, and each model will be fitted with electric lighting and starting specially designed for that particular chassis. In the after-war production program the Fiat Co. is taking up the manufacturing of commercial vehicles, also the production of the agricultural tractor.

The illustration shows a brake-equalizer design used on the United States motor trucks. The importance of a brake equalizer lies in the fact that the same pressure is applied to both wheels and makes skidding from uneven brake pressure impossible. The



action of the brake equalizer here shown is as follows: When strain is applied to the lever *A*, which carries the bevel pinion *B*, sectors *C* and *D* and the shaft are related until resistance is effected by one of the brakes being engaged. But should resistance of one brake take place somewhat ahead of the other, motion through the bevel pinion *B* is caused on the opposite sector until it is also engaged; then the differential movement ceases and equal strain is applied to both brakes.

The Ford Motor Co. announced on Jan. 1, 1919, a new minimum wage scale of $6 a day, which is a flat increase of $1 a day for approximately 28,000 employees. Coincident with the announcement of the wage increase it was made known that Henry Ford had formally resigned as president of the company and his son Edsel became executive head of the corporation, which represents an investment of nearly $200,000,000.

The Tractor Division of the S. A. E. submits the following recommendations about the speed and widths for power belts and pulleys: "Tractors shall be equipped with pulleys giving a belt speed of 2600 ft. per minute at the crown of the pulley. The pulley shall be as large as possible and the widths vary according to the horsepower delivered. Under 20 hp. the pulley width shall be 6½ in. and the belt width 6 in. For 20 to 30 hp. a pulley width of 7½ in. and a belt width of 7 in. are recommended."

The Motor Division, Quartermaster Department, has informed the Liberty truck manufacturers that they can manufacture and sell the parts of this truck or complete assembly of the chassis for commercial use. However the drawings, workmanship and material have to be held in connection with the Government specifications, giving the right to the Government to purchase the Liberty motor parts if an emergency arises.

The Selden Motor Vehicle Co. is represented with seven truck models in 1919. The three 1-ton trucks are offered with worm or internal gear drive, the two 2-ton trucks having four speeds this year, and the 3½- and 5-ton models have their gearsets mounted amidships. Each of the seven models has a Continental engine, a Brown-Lipe dry-disk clutch and a Brown-Lipe selective gearset. Starting and lighting equipment is supplied with each model.

The "dope" used on airplane wings to render the fabric taut and waterproof commonly consists of a solution of cellulose acetate. Among the more common solvents for the acetate are acetone and combinations consisting largely of tetrachlorethane and alcohol. To dissolve the nitrate the usual solvents such as amylacetate and acetone are used. To preserve the flexibility of the coating and modify the shrinkage power some substance such as castor oil is usually added to the "dopes." The great difference between the coatings given by cellulose acetate and cellulose nitrate "dopes" is the inflammability of the latter. That cellulose acetate "dopes" leave a noninflammable finish is well illustrated by the fact that when gasoline is poured on a piece of fabric coated with a good cellulose acetate "dope" and allowed to burn the fabric does not ignite. The same test applied to a cellulose-nitrate "dope"-coated cloth results in the immediate ignition of the coating. Smoothness and adhesion are very important requirements of airplane "dopes." An interesting calculation has been made by the National Advisory Committee for Aeronautics, showing that in a moderately large machine the difference in wind resistance between a "doped" and an "undoped" fabric would correspond to a difference in lifting power of from 150 to 180 lb. As regards the adhesion a good "dope" should adhere well to the fabric, so that in case of a break in the cloth the coating will not be started and peel off.

Sparks from the

Independent Steel Firms Open Export Office

Eight of the Largest Producing Companies of the Country Are Represented in the New Organization

The organization formed by the independent steel manufacturers to handle their export trade has been incorporated in the state of Delaware with a capital of $10,000,000. Active business was started on Jan. 2 with the opening of general offices in the City Investing Building, New York.

The Consolidated Steel Corporation, which is the name finally adopted, will be the exclusive agency for exporting the merchant iron and steel products of the following companies: Bethlehem Steel Co., the Brier Hill Steel Co., Cambria Steel Co., Lackawanna Steel Co., Republic Iron and Steel Co., Sharon Steel Hoop Co., the Trumbull Steel Co., Whitaker-Glessner Co. and the Youngstown Sheet and Tube Company.

Together these companies control more than one-quarter of the steel-making capacity of the country and their annual ingot capacity is about 12,000,000 tons. It is expected that other companies will join until substantially all important steel producers of the country, outside of the United States Steel Corporation, will be represented.

The president of the organization is E. A. S. Clarke, who resigned from the presidency and directorship of the Lackawanna Steel Co. in order to devote his full time to the new enterprise. H. H. Barbour, the vice president, was formerly with the Lackawanna Steel Co., and the same is true of L. W. Hesselman, secretary and comptroller, and A. Van Winkle, treasurer. Mr. Hesselman was comptroller of the Lackawanna company, and Mr. Van Winkle was secretary to Mr. Clarke when he was at the head of that concern. The traffic manager is William Heyman, formerly foreign freight agent of the Delaware, Lackawanna & Western R.R. The board of directors consists of the heads of the constituent companies.

Foreign offices are to be opened and representatives appointed to cover every part of the world where American iron and steel products are usable.

* * *

Use Motion Pictures to Present Annual Report to Stockholders

It is announced by Tampton Aubuchon, general manager of the Louisville Industrial Foundation, the so-termed million-dollar factory-fund of Louisville, Ky., that the organization's annual report to the stockholders will be partly rendered in motion pictures, and will include views of the manufacture of automobile axles, overalls, clothing, tobacco, wood products, soap, oil, bed springs, heating apparatus, furniture, etc. It will be expressive in a measure of the character of industries located in Louisville as well as the type of skilled mechanics employed.

About twenty new industries have been located in the city of Louisville as the result of the foundation's activities, and camera men are busily engaged in photographing the salient features of the various new factories in order that an intimate review of the industries, their processes and products, may be presented to the stockholders and the citizens.

The idea of presenting an annual report in moving pictures is unique, and it is believed to be original in its application in Louisville.

* * *

Date of Third Sample Fair at Bordeaux Fixed

Preliminary announcement of the holding of the third sample fair at Bordeaux, France, has recently been made by the committee of organization and administration, and the date is now fixed for May 16 to 31, 1919. A special invitation to participate is extended to American exporters and manufacturers.

The Bordeaux Sample Fair, which is held under the auspices of the General Council of the Department of the Gironde, the Chamber of Commerce of Bordeaux, and the municipal council of the city of Bordeaux, appears to be on a permanent basis, being backed by a group of local financiers known as the Société de la Foire de Bordeaux. Though inaugurated since the war began and under trying conditions the exposition has prospered and grown, the total turnover of business for exhibitors amounting in 1916, the first year, to 15,000,000 fr. and in 1917 to nearly 25,000,000 fr. Exhibitors at the first and second fairs numbered approximately 1200 each year and a considerable increase is expected for 1919.

American exporters and manufacturers who are interested in expanding their trade with France and in French colonial territories should find this fair an excellent opportunity to reach buyers from all parts of the country. With the prospects for the bettering of both shipping and commercial conditions by next spring the Bordeaux fair will be all the greater in importance. Applications for space, descriptive booklets and terms should be addressed to the Comité d'Organization et Administration de la Foire de Bordeaux, Hotel de Ville, Bordeaux.

Market in Finland for Machinery, Machine Tools, Etc.

Four years ago Finland depended largely on Germany for its manufactured articles from household utensils to the heaviest machinery. Today it is generally conceded that the United States will be the most serious competitor of Germany in the Finnish market.

One of Finland's largest importers recently remarked that there are plenty of first-class firms in Finland that would be only too glad to accept the agency of solid American firms, and most of them are already looking for first-class connections in America.

Among the numerous articles needed by Finland are agricultural machinery, gasoline engines, machine tools and instruments, sewing machines, bicycles, automobiles, motor boats, household utensils, typewriters, adding machines, cash registers, safes, locks, rifles, revolvers, post-office boxes, copper, moving-picture machines, rubber tires and all kinds of rubber articles.

* * *

War Plant to Find Peace Jobs For Men

The Minneapolis Steel and Machinery Co., Minneapolis, Minn., acting upon its own initiative, is establishing a department by means of which it hopes to find employment at once for every man thrown out of work by the completion of Government munition contracts. About 2500 will be affected at different times as work on the various contracts is finished, and it is the plan of the company to be able through this department to place every man with some other industry.

* * *

Lackawanna Steel Co. Makes Official Changes

Changes in the official personnel of the operating forces of the Lackawanna Steel Co.'s plant at Buffalo have been announced as follows: T. H. Mathias, formerly assistant general superintendent, has been appointed general superintendent, succeeding G. F. Downs, who has been made a vice president in charge of operation, and G. W. Whitehead, formerly assistant superintendent, who has been appointed assistant general superintendent. Both of the new appointees have their headquarters in the general offices of the company at the plant.

* * *

The A. S. M. E. Spring Meeting

The spring meeting of the American Society of Mechanical Engineers will be held in Detroit and the date has been tentatively announced as June 17 to 20.

World's Industrial Forge

By E.C.Porter, News Editor

Discovers a Substitute for Platinum

Announcement is made by the Chemicals Division of the War Industries Board of the discovery of a new substance to take the place of platinum in the manufacture of sulphuric acid. The discovery was made during the later days of the war. Sulphuric acid is required in the manufacture of high explosives, and a serious stringency was being faced due to the scarcity of platinum and the difficulty of obtaining it, even in small quantities, from Russia.

In the manufacture of sulphuric acid, sulphur dioxide (SO_2) is first obtained by burning sulphur pyrites. This sulphur-dioxide gas, after being dried, is passed over magnesia containing a small percentage of platinum. In this process the sulphur dioxide takes up an additional atom of oxygen (O), thus forming sulphur trioxide (SO_3). This sulphur trioxide in turn is passed through water (H_2O), forming sulphuric acid (HS_2O_4).

In the above operation the platinum performs the function of a catalyst in that it quickens the process of converting the sulphur dioxide into sulphur trioxide. Not only has the new catalyst been demonstrated as practical in laboratory tests, but a commercial plant has been established which is producing the substance in quantity. Not only is it cheaper than platinum, but it has been found to be less sensitive to "poisoning." Altogether, the discovery is regarded as a distinct advance in the art.

The same catalyst has been tried out successfully in a modified Deacon process for making chlorine gas in connection with the manufacture of mustard gas. By its use it has been found possible to effect a considerable saving in the electrical horsepower required by the process. Ordinarily for the manufacture of 100 tons of chlorine 20,000 hp. would be required. With the use of the new catalyst the same quantity can be made from 2000 horsepower.

The Fellows Gear Shaper Co.'s Annual Bonus

In accordance with a policy decided on three years ago the Fellows Gear Shaper Co., Springfield, Vt., this year paid a bonus to every man and woman who entered its employ before Dec. 1 and was still employed on Dec. 24, the date on which the bonus was distributed. This bonus was based on the yearly earnings, including the regular 10 per cent. bonus for full time and all overtime. The minimum rate was 2 per cent. for the first and second years and 1 per cent. for each succeeding year up to 10 per cent. For instance, those entering the employ of the company during 1918 received 2 per cent. on their total yearly earnings, and those in the employ of the company for 10 years received 10 per cent.

For the year 1918 over 400 employees shared in the bonus, which amounted to a total of approximately $14,500. Thirty per cent. have been with the company more than three years, receiving the bonus since its inauguration, and slightly over 5½ per cent. of these employees have been with the company 10 years or more. This is rather remarkable when we consider the conditions which were brought about by the war.

A further policy of the company is that in reference to employees who have entered the service of our country. These men upon their return will receive a bonus which will be based on their earnings for the time of previous employment. At the same time all employees who have entered Government service will not upon their return be considered as new employees, but will still retain their same rank as far as number of years of service is concerned.

While it is true that within the past year a large number of new employees have entered the service of this company the old spirit of loyalty has been maintained. The endeavor throughout is to create and maintain a family spirit, having the surroundings, conditions of labor and so forth as congenial as it is possible to make them.

Local Meetings of the A. S. M. E.

A meeting has been arranged for Jan. 29 at the Hotel Statler, Buffalo, at 8:30 p.m. Nathan L. Lieberman will deliver an address on "Horsepower Requirements of Aeroplanes and Power Consumption through Parasite Resistance."

The Philadelphia local will hold its monthly meeting in the Engineers' Club on Jan. 28. William B. Dickson, vice president and treasurer of the Midvale Steel and Ordnance Co., New York, will deliver an address on the subject of "Relations Between Employer and Employee."

Kempsmith Komments

Kempsmith Komments is a live little paper of 28 6 x 9 pages published by the Kempsmith Manufacturing Co., Milwaukee, Wis. Not only is the paper full of items of interest to the employees, but there is a good article on apprenticeship by Stewart Scrimshaw, supervisor of apprentices of Wisconsin.

Machinery Import Rules To England Relaxed

New Order to Continue Until Mar. 1, and Is Expected to Be Extended After That Date

For the information of exporters in the United States who are interested in the relaxations of import restrictions in countries abroad the War Trade Board announces in a new ruling (W. T. B. R. 490) that it has received advice that the following commodities may be imported into Great Britain without the necessity of obtaining an individual import license therefor:

THE LIST OF COMMODITIES

All machinery driven by power and suitable for use in cutting, working or operating on wood, including sawing machines of all descriptions, general joiners, mortise, tenon and boring machines; lathes and rounding machines; box and cask making machines, and all machinery accessory thereto; scraping and sandpapering machines; wheelwright machinery; firewood making and bundling machinery; wood, wool, fiber and pulp machinery; saw sharpening and setting machines; saw stretchers and brazing apparatus; all machines for grinding, planing or molding irons; all machine tools and machinery driven by power and suitable for use in cutting, stamping or working metal, including lathes, milling machines, drilling machines, planing machines, shaping machines, screw chucking machines, boring machines, slotting machines, grinding machines, boring and turning mills, power presses, punching and shearing machines, forging machines, cutting-off machines, gear-cutting machines, centering machines; leather gloves; coffee, and tobacco, manufactured and unmanufactured, including cigars and cigarettes.

This list, together with the list contained in W. T. B. R. 390, Dec. 9, 1918, contains all the commodities as to which the War Trade Board has had notice of import relaxations by Great Britain up to the present time. It is stated that these relaxations are to continue only until Mar. 1, 1919, but it is anticipated that at that time they will be again extended.

The War Trade Board is also informed that shipping recommendations from the Priority Board at Cairo are no longer required in connection with transshipments in the United Kingdom of goods destined for Egypt, and that the government of India has withdrawn its prohibition against the importation of motor cars, chassis, motorcycles and parts and accessories thereof.

Babcock Printing Press Co. Takes Over Property

Title to the property of the Reed-Prentice Co., formerly the Brown Cotton Gin Co., New London, Conn., was taken recently by A. B. Leach & Co., bankers of New York, acting on behalf of the Babcock Printing Press Manufacutring Co.

It is stated that this company will make some changes and will modernize some of the old buildings of the plant. It is the intention to put the business on a production basis. Jigs and fixtures will be used and the product will be so standardized as to permit interchangeability of parts.

The present officers are: President, Charles A. Collard, who has been connected with the sales management of the company for many years; vice president and manager, James E. Bennett, connected with company for the past 12 years, and is secretary of the Printing Press Manufacturers' Association of the United States; treasurer, Mrs. George P. Fenner; secretary and assistant treasurer, Wilfred D. Wells, who has been connected with the company for over 30 years; chief engineer, Fred S. English; general superintendent, Howard L. Hetherington, both of whom have been with the company for nearly 20 years.

* * *

Making More Edge Tools Now

With the coming of peace there has been an increase in the assortment of tools in contradistinction to the radical reduction which was a marked feature of the conservation policy of the War Industries Board.

In the line of edge tools, such as axes, hatchets and hammers, where there was only one finish, natural colored black, there is a restoration of polished, bronzed and in some cases nickel-plated finishes.

Other lines of edge tools temporarily discontinued, such as certain styles of planes, are now being furnished by manufacturers as in the days before the war.

* * *

Greatest Oil Output in 1918

Preliminary estimates by the United States Geological Survey, Department of the Interior, indicate that the quality of petroleum marketed from oil wells and field storage tanks in the United States in 1918 amounted to 345,500,000 bbl., an apparent gain of 3 per cent. over the former record output of 335,315,601 bbl. established in 1917.

The output in 1918 includes no less than 6,500,000 bbl. of crude oil removed from field storage during the year. The surface reserve of crude oil held by oil producers and pipe-line companies in the United States at the end of 1918 is estimated at 123,000,000 bbl. compared with 150,000,000 bbl. at the end of 1917. The Geological Survey's detailed statement of petroleum production will be made public in a few days.

Business Items

The Vanadium-Alloys Steel Co., Pittsburgh, Penn., has opened a Chicago office at 566-568 Randolph Street.

The International Oxygen Co. has moved its general offices from 115 Broadway, New York, to the company's Waverly works at 796 Frelinghuysen Ave., Newark, N. J.

The Fansteel Products Co., Inc., has moved its New York office from 2 Columbus Circle to 15 Park Row, New York.

The Lancaster Steel Products Co. has opened a Western office in the United Motors Building at 2715 South Michigan Ave., Chicago, Ill. Frank N. Adgate has been placed in charge of this office.

Obituary

WALTER V. TURNER, manager of the engineering department of the Westinghouse Air Brake Co., died in Columbia Hospital, Wilkinsburg, Penn., Jan. 9, 1919, following a brief illness.

LEO JULIUS LEFFLER, secretary of Chas. Leffler & Co., 59 Clymer St., Brooklyn, N. Y., died on Dec. 20, 1918.

ROGER SHERMAN MITCHELL, late of the Philadelphia sales office of the Worthington Pump and Machinery Corporation, Deane Works, died at his home in St. Davids, Penn., Dec. 20, 1918, after a lingering illness of several months.

WILLIAM M. LANGWILL, who had been in charge of the Watertown warehouse of the Crane & Ordway Co., died on Nov. 12, from pneumonia. Mr. Langwill was born Sept. 6, 1885. He entered the employ of the Crane & Ordway Co. in 1908, took charge of the Watertown warehouse in 1910, and continued in that position until the time of his death.

* * *

Scarcity of Timber Supplies in European Countries

Metal construction will undoubtedly replace wood construction to a great extent in many of the leading European countries owing to the numerous demands made upon the timber supplies during the past four years of war. It is reported that one-half of the forests in Great Britain were cut down during the war.

* * *

Will Use Shop Refuse for Fuel

New Orleans sash and blind factories will use shop refuse as fuel this winter as a fuel-conservation measure. Many of the plants in this Southern city have decided to use no coal and are remodeling their boilers in order that they can use scraps as fuel.

Will Hold Automobile Show

The Automobile Dealers' Association of New York has completed its arrangements for the automobile exposition which will be held in Madison Square Garden from Feb. 1 to Feb. 15. This will be the first time that the dealers of the city have conducted an automobile show. The regular national show, which would have been held early in January, was called off several weeks ago by the National Automobile Chamber of Commerce owing to the war.

With the improved conditions in the motor industry since the signing of the armistice, the announcement by the Government that all restrictions on production would be taken off after Jan. 1, and the abrogation of the proposed war taxes on automobiles by the Senate committee in charge of the Revenue bill, the dealers felt that the time was ripe for a New York show. The Grand Central Palace, where the recent shows have been held, could not be obtained, as the building has been taken as a Government military hospital.

The first week of the show will be devoted exclusively to passenger cars and accessories, and the second to commercial cars of all types.

Personals

P. J. F. BATENBURG has resigned his position with the Four Wheel Drive Co., Clintonville, Wis., with which he has been associated as chief engineer and designer for the past eight years.

THOMAS P. ORCHARD, formerly production manager of the New Britain Machine Co., New Britain, Conn., has joined the Service Engineering Co., 25 Church St., New York, as sales engineer.

STURE OSMAR, vice president and general manager of Lindstedt & Co., Stockholm, Sweden, is expected to arrive in America about Feb. 1. The purpose of Mr. Osmar's visit is to make agency arrangements with leading American manufacturers of machinery, tools and accessories. Correspondence for Mr. Osmar may be addressed for his personal attention in care of the Swedish Gage Co., 245 West 55th St., New York. The capital of Lindstedt & Co. has recently been increased to 4,000,000 crowns (approximately $5,000,000).

GEORGE W. FELTON, formerly assistant chief engineer with the New Process Gear Corporation, Syracuse, N. Y., has taken the position of factory superintendent with the Crofoot Gear Works, Inc., Cambridge, A Branch, Boston, Mass.

JAMES J. SHANAHAN has been appointed general manager of the Chicago and Moline offices of the E. L. Essley Machinery Co., 551-557 Washington Blvd., Chicago.

GEORGE A. FRENCH, formerly with the Cutter and Wood Supply Co., Bos-

ton, Mass., has become sales engineer for the Shepard Electric Crane and Hoist Co., Montour Falls, N. Y.

S. E. HACKETT, formerly sales manager of the Chicago office of the Jones & Laughlin Steel Co., has been made general sales manager of that company to succeed the late John L. Haynes.

H. C. WHITE, formerly factory manager of the Holt Manufacturing Co., Stockton, Calif., is the new factory manager of the Harris Engineering Co., Stockton, Calif.

FRED E. ROGERS, JR., formerly with the J. G. White Co., New York, has taken the position of sales engineer with the Fafnir Bearing Co., New Britain, Conn.

JOHN J. EYRE, recently with the Worthington Pump and Machinery Corporation, has accepted the position as factory engineer with the Sturtevant Aeroplane Co., Boston, Mass.

Trade Catalogs

Mallet Articulated Locomotives. The Baldwin Locomotive Works, Philadelphia, Penn. Record No. 91. Pp. 44; 8½ x 6 in. A thorough description and illustration of the various types of Mallet articulated locomotives, which are used by several railroad companies is given. Formulas for calculating the traction force of locomotives and tables of weights and dimensions are also presented for general information.

1919 Diary. Morse Chain Co., Ithaca, N. Y. It is 2½ x 4¼ in. and contains many pages of general information with illustrations and tables regarding chain drive. Calendars for 1919 and 1920, postal information, weights and measures and other useful information. Many blank pages with dates are given for making notes, etc.

Small Tools. Greenfield Tap and Die Corporation, Greenfield Mass. Catalog No. 40. Pp. 288; 4¾ x 7¼ in. This is a new catalog, and lists a line of taps, dies, screw plates and reamers. Many tables of general information regarding numbers, sizes prices, etc., are given.

Space and Speed in Steel Buildings. Milliken Bros. Manufacturing Co., Inc., Woolworth Building, New York. Booklet. Pp. 24; 6¼ x 9¼ in. This booklet is descriptive of the standardized truss unit system of building construction designed and manufactured by the company. It contains a number of halftone illustrations showing the use of the standardized truss unit system. A copy will be forwarded to those interested.

Economical Handling of Coal and Ashes and Reserve Coal Storage. Link-Belt Co., Philadelphia, Chicago and Indianapolis. Book No. 353. Pp. 52; 6 x 9 in. There are 88 illustrations of various kinds of machinery for handling coal in this brochure and much descriptive matter explaining the different kinds of elevating machinery for the economical handling of coal and ashes. It is new and will be forwarded to interested persons on request.

Spur Gear Cutting Machines. Waltham Machine Works, High St., Waltham, Mass. Booklet. Pp. 14; 4¼ x 6¾ in. It gives halftone illustrations and sectional-plan views of the machine, together with general specifications and a detailed description of the driving mechanism, cutter spindle and slide, work spindle and slide and general directions.

Subpresses and Dies. Waltham Machine Works, High St., Waltham, Mass. Booklet. Pp. 16; 4¾ x 6¾ in. An illustration is given of the cylindrical subpress, pillar subpress, simple dies, tandem or follow dies and compound dies. The booklet also contains several paragraphs on blanking, piercing, bending, trimming and shaving. The last page shows a table of standard dimensions of subpresses.

Thread-Milling Machines. Waltham Machine Works, High St., Waltham, Mass. Circular, 6½ x 10½ in., giving general specifications of thread-milling machine for bench use, also for the extended machine and some features of design.

New Publications

The Automobile Storage Battery: Its Care and Repair—Two hundred eighty-four 5 x 7½-in. pages; 186 illustrations; Bound in limp leather, handbook style. Published by the American Bureau of Engineering, Inc., 1024 South Wabash Ave., Chicago. Price $5.

Many books have been written on storage batteries used in stationary work, but the stationary storage battery is never subjected to the racking service of the storage battery used in the modern gasoline car. Consequently the books on the stationary type are of very little use to the man who has to do largely with those used in automobiles. It is perfectly true that the chemical actions are the same in all lead-acid storage batteries, but the design, construction and operation of the starting and lighting battery are unique and require special description and care. This book deals only with the automobile type of lead-acid storage battery and is just the book that the practical repair man, student or progressive car owner wants. No one but a practical man and an engineer could have written the book, for it covers the subject so thoroughly and in such a clear way that even those with no previous knowledge can understand the battery construction, details and troubles. The book is divided into two sections. The first deals with the theory, design, operating conditions and care of the battery; the second with the actual work of repairing and rebuilding the storage battery. This section is of especial value to repair men.

The first section is divided into chapters as follows: Introductory, Batteries in General, Chemical Actions Which Produce Electricity, How Chemical Actions Produce Electricity, Loss of Charge in an Idle Battery, The Discharge Phenomena, The Charge Phenomena, Capacity of Storage Batteries, Internal Resistance, Battery Diseases, Conditions of Operation, How to Take Care of Battery on the Car, Manufacture of Storage Batteries.

The chapters in section II are: The Workshop, General Instructions, Analysis of the Condition of the Battery, Work on the Battery, Special Instructions and Cadmium Test-Storing Batteries.

Descriptive Geometry. — By William L. Ames and Carl Wischmeyer. One hundred and twelve 5 x 7½-in. pages; 197 figures. Fifth edition. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York. Price, $1.

This is an enlarged edition of the original "Notes on Descriptive Geometry," by Professor Ames, first published in 1893, and which was probably the first book on the subject which used the third quadrant. It is an odd fact too that while the third quadrant is used almost exclusively in drafting rooms today the various books on descriptive geometry largely teach the first quadrant projection. Professor Ames was formerly professor of machine design in Rose Polytechnic, and Professor Wischmeyer is at present associate professor in the same institution. Both men are especially qualified to compile a book of this kind—Professor Ames as the originator and Professor Wischmeyer as reviser and selector of the additional material put into this edition. The principal changes are the increased number of examples given for the instruction of students. The chapters deal with the Introduction, Representation of Points, Representation of Lines, Representation of Planes, Representation of Simple Solids, Assuming New Planes of Projection, Change of Position by Rotation, Lines with Reference to H and V, Planes with Reference to H and V, Development of Surfaces, Line Contained in Plane, Intersections, Perpendiculars, Angles, Distances, Tangent Planes, Shades and Shadows, Sections, Intersections of Surfaces, Helicoidal Surfaces, Hyperboloid of Revolution of One Nappe, Practical Applications, Impossible and Indeterminate Exercises.

The Gasoline Motor.—Vol. I.—By P. M. Heldt. Six hundred and thirty-six 5½ x 8¼-in. pages; 378 illustrations; 32 plates. Published by P. M. Heldt, Nyack, N. Y. Price, $5, postage paid.

The fact that this is the fifth edition indicates that this book has become a recognized authority in its field, which, although not indicated in the title, is that of the motor vehicle. Much of the information is useful in other lines, but the book deals with the motor used for transportation purposes and may perhaps be likened to Unwin and Carpenter, except as to the field covered. It begins with the working principles of the interval-combustion motor and then takes up the essential parts, shows what work each performs and how it should be designed. It takes up the materials used, the calculation of stresses and necessary dimensions, common faults in different parts and how these may be avoided. Manufacturing methods are also discussed and the practice of different makers shown. There are 22 chapters and an appendix, these including Balancing; Offset Cylinders; Crankshafts; Connecting-Rod; Camshaft and Valve Mechanisms; Oiling Systems; The Different Cycles; Air and Water Cooling, special chapters being devoted to testing methods and to designs of unusual and unconventional types. The appendix contains many tables of value for the designer. It seems to be the general belief that we are to see many changes in motor design during the next few years, utilizing to a considerable extent the experience gained with airplane engines, but whatever changes are made the designer will do well to have a copy of this book at his elbow, for the author is known to be a careful engineer and an authority on the subject of motors.

Storing: Its Economic Aspects and Proper Methods.—By H. B. Twyford. Two hundred 6 x 9-in. pages; 96 illustrations and forms; bound in green cloth boards. Published by D. Van Nostrand Co., 25 Park Pl., New York. Price, $3.50.

Various problems of the proper storage of raw and finished product are constantly confronting the manufacturer and his staff. Each case must be studied individually, but it is helpful to know how certain problems have been handled by others and what equipment is available. The author of this book treats in a broad way of the handling methods, storage methods and forms to be used in keeping an accurate record of stock. He has no "scientific management" hobby to ride, and his handling of his subject cannot fail to be helpful to those looking for information of a constructive nature. The illustrations are well chosen and the text is clear and to the point. The various chapter headings are: General Considerations; Economic Questions Connected with Storing; Economic Questions Connected with Storing (Continued); Specifications, Definitions and Standardization; Location and Equipment of Storeroom; Appliances for Use in Storeroom; Manual Operations; Clerical Work-Inventories; The Stores Department; Receiving Material; Inspecting and Placing Material in Storeroom; and Deliveries for Storeroom.

Forthcoming Meetings

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$37.60	$37.60
Northern Basic	34.80	34.80
Southern Ohio No. 2	35.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	39.55	39.15
Virginia No. 2	41.70	41.70
Southern No. 2	41.70	41.70
BIRMINGHAM		
No. 2 Foundry	34.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	39.15*	38.85*
Virginia No. 2	40.50†	40.50†
Basic	36.90*	36.60*
Grey Forge	36.90*	36.60*
Bessemer	39.10*	38.80*
CHICAGO		
No. 2 Foundry Local	34.50	34.50
No. 2 Foundry Southern	39.00	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35.40	35.40
Basic	34.40	34.40
Bessemer	36.60	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.07	$4.27	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	4.17	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	4.17	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.77					
Plates, ¼ to 1 in. thick	4.27	4.52	4.45	4.42	4.39	4.27	4.20

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$3.50
Warehouse, New York	4.75	4.70
Warehouse, Cleveland	3.90	4.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	New York Pittsburgh Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.52	6.445	5.75	6.45	6.22	6.445
*No. 26 black	4.60	6.12	6.42	6.405	5.65	6.35	6.12	6.405
*Nos. 22 and 24 black	4.55	6.07	6.37	6.295	5.60	6.30	6.07	6.295
Nos. 18 and 20 black	4.50	6.02	6.32	6.245	5.50	6.25	6.02	6.245
No. 16 blue annealed	4.10	5.37	5.72	5.645	4.95	5.65	5.37	5.645
No. 14 blue annealed	4.00	5.27	5.62	5.545	4.85	5.55	5.27	5.545
No. 10 blue annealed	3.90	5.17	5.52	5.445	4.75	5.45	5.17	5.445
*No. 28 galvanized	6.05	7.57	7.77	7.695	7.15	7.70	7.57	7.695
*No. 26 galvanized	5.75	7.27	7.47	7.395	6.85	7.40	7.27	7.395
No. 24 galvanized	5.60	7.12	7.32	7.245	6.70	7.25	7.12	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.30
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire*	
5/16, 11/32, 3/8, 1/4, 7/32, 9/64 No. 8, 5/32 and No. 10	25.50 to 33.00
No. 12	
1/8, No. 14 and 5/64 No. 18 No. 20	

* Very scarce.

Cast-Iron Welding Rods	
5/16 by 12 in. long	14.00
1/4 by 19 in. long	12.00
3/8 by 19 in. long	10.00
1/2 by 21 in. long	10.00
* Special Welding Wire	
1/4	33.00
5/32	30.00
1/8	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.77	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼, and ⅜	47%	20½%	½ to 1¼	36%	20%
½	51%	36½%			
¾ to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD. EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	43%	25½%	½ to 1¼	36%	21%
½	48%	35½%			
¾ to 1¼	52%	39½%			

LAP WELD. EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅛ to 3 in. steel butt welded	42%	27%	43%	26%	41.1%	26.1%
3½ to 3 in. steel lap welded	38%	29%	39%	23%	37.1%	23.1%

Malleable fittings, Class B and C, from New York stock sell at list + 12½%. Cast iron, standard sizes, 10% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	20.50*	26.00	23.50
Tin in 5-ton lots	72.00	72.00	85.00
Lead	5.75	7.05	6.50
Spelter	7.85	8.60	8.00
ST. LOUIS			
Lead	5.45	6.75	6.35
Spelter	7.50	8.25	7.55

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	29.00	38.00	31.00	35.00	32.50	32.00	35.00
Copper wire (carload lots)	28.00	35.00	32.00	32.00	28.50	31.00	34.00
Brass sheets	29.00	39.75	30.75	32.00	33.00	29.00	35.00
Brass pipe	37.00	46.00	36.50	38.00	40.00	37.00	41.00
Solder (half and half) (case lots)	41.00	55.00	48.00	44.00	43.25	39.00	41.50

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$26.00	$25.00
New York	27.40	30.00
Cleveland	30.00	34.00
Chicago	28.50	37.00